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THE CLASSIFICATION OF THE STATISTICAL EMPLOYEES OF THE UNITED STATES GOVERNMENT AT WASHINGTON

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The nature of any classification must depend on the purposes to be achieved through its use, and accordingly in discussing the work of the Congressional Joint Commission on Reclassification of Salaries in respect to the statistical employees of the government at Washington, it is desirable to begin with a statement of what the commission sought to accomplish, in so far as one may justly attempt to formulate purposes of a commission.

The immediate object of the commission can perhaps be best set forth by quoting a paragraph from the act of Congress creating it:

> "It shall be the duty of the commission to investigate the rates of compensation paid to civilian employees by the municipal government and the various executive departments and other governmental establishments in the District of Columbia, except the Navy Yard and the Postal Service, and report by bill or otherwise, as soon as practicable, what reclassification and readjustment of compensation should be made so as to provide uniform and equitable pay for the same character of employment throughout the District of Columbia in the services enumerated."

Persons familiar with the government service will at once appreciate that such an authorization from Congress permitted of two courses. The commission might submit a report that would permit of a temporary realignment of salaries without attempting to correct those forces which have produced the existing evil conditions. On the other hand, it might recognize the dynamic nature of the problem of handling a force of over 100,000 employees engaged in hundreds of diverse under-

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takings; and it might attempt to devise a continuing mechanism to preserve a permanent, uniform and equitable alignment in salaries and to correct those forces that have caused conditions of employment in the government service to become notorious. It could have given a narcotic to remove the symptoms, or it could have attempted to map out a régime of right living that would ultimately eradicate the causes.

The commission never hesitated in its choice. Whatever criticism may be leveled at the commission's work, it can never be fairly said that the commissioners did not broadly interpret their responsibilities, that they did not welcome suggestions and advice from every person who thought he had something to contribute to the success of the undertaking, or that they sought to save themselves work. Broad interpretation of their responsibilities, democracy in organization and management, a willingness to listen, though undoubtedly with more than two members, figuratively, from Missouri, and a tendency to be constantly on the job, were the dominating characteristics of the commissioners. They sought to achieve a broad fundamental reform in the methods of employment management in the civil service.

This fundamental decision necessarily exerted a profound influence on the classification they developed. Had the commissioners taken the narrow view or sought to avoid work, they could easily have established a comparatively small number of salary grades and assigned each position to one of these grades. In other words, they could have duplicated the classification processes that were applied about the middle of the last century. They might have gone a little further than that and have attempted to write out for each salary grade a statement of the duties and responsibilities which would justify placing an employee in this grade. Such definitions would have been of the blunderbuss variety and would have lumped together employees doing things which were very unlike, but which were believed to be of equal value to the government. This course would have had the great merit of apparent simplicity, but it would have been of comparatively little aid in achieving the fundamental reforms that the commission determined were necessary.

To make a complete enumeration of all the detailed objects to be secured through the application of the classification is doubtless beyond the power of any one observer, but some of the more important ones can be discussed.

For the purposes of recruiting suitable employees for the service, it has long been felt that more specific tests of qualifications could be given. To give specific tests of a candidate's qualifications for a particular craft or line of work, it is first necessary to know what qualifi-

cations a person must possess to perform those duties satisfactorily. That is almost painfully obvious, and, of course, the Civil Service Commission has known it; but it has not had the funds and equipment to make a study of the entrance qualifications necessary for the individual positions or to give more minute examinations designed specifically to test for those qualifications. It has given for many positions broad, general examinations, testing an employee's general education and ability; but it has not found whether the employee has the ability, knack, or inclination that leads to success in the particular job. The Reclassification Commission designed a form of classification that would ultimately lead to the formulation of a statement of the specific requirements for the particular jobs. It made a preliminary statement of the required entrance qualifications, a mere beginning. Experience will modify and perfect these statements, but it was believed that a good classification of positions, to be of service for recruiting, must possess an analysis of the requisite qualifications.

Similarly, the commission sought to develop a classification that would be useful in regulating promotion. It made a vital distinction, not now generally recognized in the federal service, between an advance in salary not accompanied by any increase in duties or responsibilities, and a promotion, meaning a change to more difficult work or the assumption of greater responsibilities. How vital a matter this distinction is can hardly be appreciated by one who has not been in a government bureau with a "statutory roll," that is, with an appropriation which specifies the number of employees to be hired at each of the specified rates of pay. In such a bureau, no employee can secure increased compensation unless there is a vacancy to which he can be advanced. When the vacancy occurs, the administrator frequently is called upon to make a choice between the employee who merits an advance in pay on the basis of meritorious performance of unchanged duties and the employee who deserves promotion because of increased duties and responsibilities. He must choose, and as a result, through the continued application of such choices, it not unfrequently happens that almost all relationship between pay and duties is lost and longevity is the real factor that determines the position on the pay-roll.

This situation the commission desired to eliminate, and consequently it recommended a classification in which advancement in pay while performing a specified class of duties, involving specified responsibilities would be semi-automatic upon demonstrated efficiency and not contingent upon the existence of a vacancy. Such semi-automatic increases must necessarily be within reasonably narrow limits, and thus a fairly minute classification was essential.

Promotion in the federal service at Washington at the present time is virtually free from any centralized control or regulation. The Civil Service Commission intervenes, practically speaking, only in so far as it is necessary to preserve the integrity of its entrance examinations, by blocking the obvious device of getting a person into the service on a low grade examination and then promoting him to a higher position. Further than this it does not go, and the selection for promotion rests virtually in the hands of the appointing officer, subject only to such restrictions as may have been placed round him by Congress in its appropriations. In administering a statutory roll, he can promote or advance an employee only when he has a vacancy, and generally speaking he can have only such a number of employees and at such rates of pay as have been specifically authorized. In administering a lump sum roll, he can have as many employees at such rates as he desires, provided the aggregate expenditure does not exceed his appropriation and provided he does not exceed any maximum limitations that may be placed upon the appropriation in respect to the salaries to be paid. One man can promote or advance at will, the other finds his hands tied.

Selection for promotion, when one may be made, is not formally competitive. The Reclassification Commisssion sought to introduce in so far as possible the competitive element. Formal set promotion examinations of the traditional type are, of course, universally viewed with suspicion, but an impartial review of the records of the candidates by an outside examiner, supplemented by such practical tests as can be devised, is probably necessary to eliminate improper influences affecting promotion. The hope of the day for successful control over promotions is the record of efficiency and adaptability displayed in the daily performance of the duties of the job.

A very little work with efficiency records will convince one that the first step in their development is a fairly minute analysis of the duties of the job. Reliable statistics of productiveness and accuracy may be kept for the routine card punch operator, and one may get very good numerical data on a group of statistical clerks doing such simple tasks as straight copying and computing. As the higher groups of statistical clerks are reached, numerical records of efficiency break down and one has to depend on a general analysis of the product and the record. If any progress is to be made with the development of records of productiveness and the general value of employees as a means of determining those to be promoted and advanced, the classification of positions must be fairly minute on the basis of the craft being followed by the employee.

Another factor that influenced the commission toward the develop-

ment of a fairly minute classification upon the basis of the craft followed was the desire to promote the development of the employee. At present the problem of training and developing employees is very largely in the hands of the supervising officer in immediate charge of getting out the work, and frequently in a given office the number of employees following a given craft is so small that any formal training for them is out of the question. They get what the job gives. If these isolated employees are classified by craft and the figures for the craft are brought together, regardless of organization lines, the figures become impressive. Can an employer of 10,000 filing clerks, scattered through many orgaization units, safely afford to leave the training and development of filing clerks to the individual units? What are the possibilities for training statistical employees at Washington, with the total number in the different branches of the work in the neighborhood of 3,243, not counting the temporary employees of the census?

The commission was impressed with the possibility of opening careers for employees in the civil service. At present the horizon of the government employee generally lies within the confines of the bureau or office to which he is first appointed, and sometimes even within the division or section of that organization. He gets in training and development as much or as little as his bureau or office has to offer; and at times he is called upon to abandon one craft he has learned and pick up another, because the work of his unit has changed or because it offers no opportunity for higher work in the craft he has learned. That he has a talent, say, for statistical work, and that the government as a whole needs employees qualified for that work, is not the vital question. Does his office need it? If not, then he must do something else or fight the system. The present system actually opposes movement from one department to another, and he who would change must have knowledge of other organizations, perseverance, and a pleasing personality or else "influence" that will win him consideration where he wishes to go, and then if he has served his three years in the department or independent establishment to which he was first appointed, he may be transferred.

The modern conception that people must be tried out a bit, so that each peg may ultimately find an appropriate hole, is absolutely contrary to the government practice. The new man works in the office to which he is assigned, and if he is a misfit—well, he is a misfit. Private organizations pursuing this employment policy "fire" the misfits, which after all is far better for the misfits than the government practice of keeping them. After a man has been a misfit around a government office for a few years, he is in the "dead wood" class. Presumably he

had some good in him when appointed, at least he was good enough to get by the civil service, and that is something; but being a misfit breaks his spirit, and by the time his three years are up his main interest is pay day, if it is not in cultivating a little congressional influence.

The commission believes thoroughly in eliminating persons who do not make good, but it believes first in giving them a real trial. For this reason, it recommends an employment policy which would tend to belittle organization lines. The Civil Service Commission would be required to follow the employees, and if they were not coming up to requirements, to make a diagnosis of the case and to replace them. The employee would be free to go to the commission if he were dissatisfied with his own situation, and to have its aid and assistance in working out his future. If he is statistically inclined and has absorbed all that the Indian Office has to offer in the way of possibilities of statistics, the commission can place him in the Census or in Labor Statistics or in any other office that needs that kind of work and is looking for persons who are anxious to do it. For work of this type, a classification by crafts is distinctly helpful.

The existing congressional opposition to transfers from one department to another is born of the absence of any standard salary rates. Not infrequently one department will pay an entrance salary as much as 50 per cent more than another for the same work. The eligible person passing a given civil service examination with the highest rating may be certified to a low paying department and may accept. A few months later a high paying department may call for a certification from the same register and get a candidate who just did pass. When the first employee discovers that another department is paying much more to others who are not so well qualified, he naturally would like to "transfer." Such a condition gave rise to the "transfer evil," and the administrators who were operating their offices on a low salary scale appealed to the congressional committees. Sometimes they used the situation as an argument for larger appropriations to enable them to meet the salaries paid by the other organizations, and at other times they merely complained against the raids that carried off their employees. The quick, direct solution was to limit transfers. If a standard salary scale were in use, this objection to transfer would be entirely eliminated.

In a cursory way this discussion has indicated some of the motives which led the commission to discard the proposal for the establishment of a few descriptive salary grades, and to develop instead a detailed classification with a division into crafts, and into classes within crafts according to the logical divisions into which crafts may be divided by

persons who are familiar with them, or who have made a detailed study of them.

The actual division into crafts and into classes within the crafts was made by the so-called "detailed" staff of the commission, men and women from the government offices selected because of their knowledge of the type of work with which they were to deal and their familiarity with the government service. They were under the leadership of a "headquarters staff" of industrial engineers experienced in personnel classification, the two principal members of which were Mr. E. O. Griffenhagen, chief counselor, and Mr. H. E. Fleming, director.

Perhaps it may not be improper to say that many of the members of the detailed staff entertained a profound hope of a possible result from the detailed specifications over which they labored so many months, examining hundreds of questionnaires, writing and revising specifications, conferring with their associates in the commission, in the departments and offices, and on the numerous advisory committees—wherever they could get enlightenment and assistance. They knew that the classification was not inseparable from budgetary reform, and they recognized the wisdom of the commission in not linking its fate to any particular budgetary legislation. The fact still remained that the item of "personal services" is one of the heaviest among government expenditures; and that although reclassification can proceed without a budget, a budget cannot get anywhere without going into the matter of salaries and salary standardization. The detailed employees were many of them practical administrators of no little experience, and collectively they knew the game. They entertained the hope that through reclassification, under a detailed, precise set of specifications, might come a better understanding between the executive establishment on the one hand and Congress on the other. They saw in this detailed book of job specifications the compromise method for appropriating for personal services, which would give to the administrators that freedom which comes from a "lump sum" appropriation while it preserved to Congress that element of control that is characteristic of a statutory appropriation.

Individual cases of abuses of lump sum appropriations in some of the war agencies, the payment of salaries out of all proportion to anything in the old establishments, made vivid the danger of uncontrolled lump sum appropriations. On the other hand, many knew from experience the difficulty of forecasting twenty-three months in advance the exact services which would be required for a bureau or division, as is necessary under a statutory roll. Frequently there are sufficient funds, but the money is so tied up that the responsible administrator is prevented

from achieving the best results. The possibility afforded by the detailed specifications was that the administrators could say to Congress: "Give us the money you think wise, control us in respect to the salaries we may pay through these detailed minute specifications which you may alter from time to time to keep us abreast of the changes in economic conditions, but leave us free to adjust our numbers and the exact disposition of our forces within these detailed specifications. Require us to estimate in advance according to the standard specifications and to report in detail in accordance with them, but give us a little freedom for adjustment." A broad set of descriptive salary grades would offer many possibilities for evasion. The detailed specifications as drafted would give to Congress a control over the actual expenditures for a given type of service that it has never yet achieved. It has in fact controlled the amount paid, but it has never determined the quality and quantity of the article purchased. This classification was designed to give to Congress detailed control over what it gets for the money spent for services.

Such are the broad objects of the classification, almost all demanding a scientific division into primary units or classes, as distinguished from a grouping of such true classes as are believed entitled to like salaries into non-homogeneous grades. Statisticians need hardly be reminded that given true classes, grouping into grades is simple enough, but to unscramble a non-homogeneous grade where the component classes are not shown necessitates doing much of the work over again.

The statistical positions in the classification are divided into three services: the statistical science service proper, the statistical clerical service, and the mechanical tabulation service.

In the statistical science service are placed those positions in which the employee is required to analyze economic, social, or related problems, to develop or to apply statistical methods in their solution or illumination, and to interpret the numerical data pertaining to the subject. A prerequisite for entrance into this service is a fairly broad familiarity with current economic and social problems and with the methods of research in these fields, which is, of course, now ordinarily secured through college and university training with some specialization in the social sciences. For the higher positions in this service, thorough knowledge of the special subject and practical experience are required, but all the positions have the common characteristic of requiring a sufficient background of knowledge and a sufficient familiarity with the methods of social research to enable the incumbent to make analyses, perhaps very elementary ones, and to interpret data in the social field, using the term "social" broadly.

The statistical clerical service includes those positions which require the supervision or performance of the clerical processes involved in the collection, tabulation, and interpretation of statistical data, exclusive of positions concerned entirely with the operation of the mechanical tabulating machines and the processes incidental thereto. The most common clerical processes involved are the collecting and examining of schedules and their preparation for tabulation, tabulation and computing, and the verifying of these processes. The upper classes in this service include the supervisory statistical clerical positions, and require successful experience in statistical clerical work and no little administrative ability, and in salary grade they outrank the lower positions in the statistical science service. They are distinguishable from the positions in the statistical science service in that they do not involve the determination of the nature and scope of the inquiry, its scientific content, or the interpretation of the results. If these duties are involved, the position goes into the statistical science service, even if the duties of the position include the supervision or the actual performance of some statistical clerical processes. The basic educational qualifications for first entrance into the statistical clerical service are: "Training equivalent to that represented by graduation from high school or from a commercial school of recognized standing, neatness in preparing papers, legible penmanship, and rapidity and accuracy in arithmetic, writing and figure copying." With these fundamental qualifications, a person may ordinarily be developed into a journeyman statistical clerk and, if possessed of administrative ability, may become qualified through experience for the highest statistical clerical positions.

The mechanical tabulation service includes those positions requiring the supervision or performance of work required in the mechanical tabulation processes, exclusively. "Exclusively" is used because if a statistical clerk incidentally operates mechanical tabulating machines as one of the parts of his general statistical clerical work, he is classed as a statistical clerk; and similarly, if a statistical scientist occasionally designs a punch card or a code, or runs a tabulator, or supervises a mechanical tabulation unit, he is still placed in the statistical science service. The highest classes in the mechanical tabulation service embrace the positions involving the supervision of important mechanical tabulation organizations, including the "laying out" of the work, the designing of cards and codes. In salary rank they may be on a par with the higher statistical clerical classes and they may be above several classes of the statistical science service. For entrance into the lower classes of this service, the educational qualification is a common school education.

"The line of normal advancement," one will at once observe, has been an important factor in influencing the classification. An intelligent person with only a common school education, entering the service as an operator of one of the mechanical tabulating machines, can from his or her office experience generally acquire the qualifications requisite for the higher positions in the service. Similarly, a person with an education equivalent to that gained in a high school can, by virtue of his or her experience alone, advance to the higher positions in the statistical clerical service. The employee in the mechanical tabulation service who has only a common school education, and the statistical clerk who has gone no further than the high school, according to this classification, are required, if they desire to go ahead along the less normal course of advancement, to supplement the development that they are getting in the every-day routine of the position by study and work that will make up for the qualifications which they lack.

The commissioners, it should be noted, were by no means sticklers for academic degrees. "Training equivalent to that represented by" was the standard phrase without which it was not permitted to specify even graduation from high school, not to mention college, and the bill submitted by the commission provided that:

> "(d) Whenever the possession of a university or college degree or a high-school diploma, or the equivalent of such degree or diploma, is prescribed as a qualification for a class, the commission [to administer the act] shall prescribe as such equivalent a standard, or standards, based on experience or demonstrated ability in the performance of duties similar to those prescribed for such class, which will be accepted as such equivalent."

The intention of the commission was to be eminently practical in the matter, and the educational requirements such as graduation from a high school, or college, or three years graduate study, were used not as arbitrary requirements but as convenient, easily-expressed measuring sticks. If a statistical clerk who has been working for years with statistics of industry wished to qualify as a statistician in that field, he would be examined not in Greek, and Latin, and ancient history to discover whether he had the equivalent of a college education, but on his knowledge of the economics of industry and on his ability to plan the scope and content of inquiries, to analyze statistics and write reports. The absence of a college education would raise a rebuttable presumption against him which would necessitate his satisfying the Civil Service Commission that he had acquired the really requisite education and knowledge in his own way. If three years graduate study was mentioned as the measure, the candidate would be expected to show not only a good general knowledge of his subject, but such an ability to

make contributions to it as might have won him his doctor's degree if he had followed orthodox academic educational lines.

The commission was alive to the unique possibilities for the training and development of employees for technical and scientific positions that are inherent in the government service. Time did not permit the development of a detailed plan for supplementing the work of existing educational agencies in the District of Columbia, which are already rendering a noteworthy service in adapting their hours and to a limited extent their courses to meet the needs of the goverment employees, but the commission recognized the duty of formulating and executing such a plan as a necessary function of an effective administrative agency concerned with the employment problem of the United States government. The establishment in the government service of a deliberate system for the training of statisticians and statistical clerks would be a great step in advance. Many statisticians in private employment have acquired much of their preliminary training and experience in the public service, and they will appreciate the fact that with only a little deliberate thought and effort this experience might have been made far richer and broader. A governmental training system would, as a matter of fact, advance the profession as a whole and would benefit all users of statistics by raising the quality of the figures.

Administration was not recognized as a distinct craft. Positions involving administrative duties, as a rule, constitute or are included in the upper classes of that special service which differentiates and gives character to the administrative office being classified. Thus the position of director of the census constitutes a "one man" class in the Statistical Science Service and not a position in a Bureau Chief Service. In its classification, the commission takes the obvious position that a director of the census should be at once a statistician and an administrator, and, similarly, that senior statisticians directing large statistical undertakings should be both statisticians and administrators.

The commission, however, did not go on record as favoring the placing within the competitive classified civil service the positions of bureau chief and other similar offices that are now filled by the President, either with or without the consent of the Senate. Its bill specifically preserves the status quo established under the Civil Service Act of 1883. The provision recommended reads as follows:

"*Provided further*, That the President may make an appointment to a position excepted from the provisions of the Civil Service Act, or exempted from examination thereunder, without regard to the qualifications specified in the classification of 1920 or the provisions of this Act relating to appointments to a position, or such rules and regulations as may be adopted thereunder; but nothing herein contained shall prevent the President, as provided by the Civil Service Act, from including such position

within the provisions of such Act or from terminating the exemption from examination with respect to such position, and thereafter such position shall be subject to all the provisions of this Act."

Legally, therefore, its carefully drawn specifications for the high positions that are now outside the competitive classified service would have the value of waste paper. What their moral value may be remains to be seen. Conceivably, they might have a powerful influence on the President in making his nominations, and on the Senate in passing upon those nominations. Whenever Congress is ready to remove all non-political offices from politics, moreover, the classification is ready to meet the situation. Ardent champions of civil service reform will find in this feature of the commission's report its most outstanding departure from sound principles of personnel administration. The answer to their criticism will have to be found in political expediency, and it will have to be admitted that the object of opening up possibilities for successful careers in the public service found a limit in political expediency.

The higher classes in the statistical science service and to a lesser extent in the statistical clerical and the mechanical tabulation services, are what the commission terms "group classes" as distinguished from "true classes." They are groups of classes which have common characteristics in respect to general duties and responsibilities, but which differ from each other in respect to the subject matter involved. Under the group class title "Senior Statistician" one will find, as illustrative specific titles, "Senior Statistician (Population), Senior Statistician (Transportation), and Senior Statistician (Vital Statistics)," and in addition to the statement of common qualifications demanded, the added requirement, "For each class in the group, specialization in training and experience in the subject matter to be dealt with in the position concerned as indicated in the title of that class."

In the lower classes of the statistical services, the employees are to a very considerable extent interchangeable, and one with good statistical clerical ability is equally serviceable whether working on vital statistics or on statistics of foreign trade; and the recent college graduate with good fundamental training in the social services can perhaps do almost equally good work in any one of a number of different bureaus. As the employee continues to serve in a given bureau, he acquires a highly specialized knowledge of the subject matter with which his bureau deals. That is obviously the case with statisticians, for they must, to be successful, know both method and subject. In a lesser degree it is true of clerks. The high-class statistical clerk is sometimes distinguishable from his lower-class fellow worker mainly because of

his clerical knowledge of the subject matter or of the procedure. He may have a precise detailed knowledge of a complex classification that makes him almost invaluable, or he may know the routine procedure as no one else knows it. This knowledge is to be distinguished from that of the statistical scientist in that the clerical knowledge would not fit an employee to throw existing classifications and procedures into the discard, and to develop new ones that would make the statistics more closely related to life. The clerk must know that a certain method of procedure is to be followed, whereas the statistical scientist must know *why* it is to be followed, and especially what social good is to be achieved. In passing, it may perhaps be remarked that failure to distinguish between these two types of knowledge in the selection of employees for important governmental statistical positions has resulted in some instances in keeping the governmental statistical output in certain important and dynamic fields practically unchanged over periods of thirty or forty years, and, as a consequence, the figures are of little practical use in illuminating current economic and social problems.

In the upper classes of the statistical services, the possession of the knowledge needed in the position is included in the entrance qualifications. To a very considerable extent such a requirement gives to the employee already in a bureau or an office an advantage over his competitors who would seek to transfer to that bureau or office from an office dealing with a different subject matter or procedure, and thus it possibly results in some narrowing of the opportunities for advancement, especially for employees in offices that are dealing with a subject that is peculiar to that individual office. If an employee wishes to change his line of work, he may find that it is necessary to accept a position in the office in which he wishes to serve lower in class than the position he has been filling in the old establishment.

Some difference of opinion exists as to the seriousness of this interference with free competition without reference to organization units or lines. My own experience has been that the value of a statistical clerk frequently turns quite as much on his grasp of the subject he is working with and on his knowledge of the office and its procedure as it does on his possession of those qualities common to all statistical clerks. The popular tendency in the past generally has been seriously to underrate the amount of peculiar and specialized knowledge that a government clerk must possess to fill the higher clerical positions in the public service. The upper government clerks are in fact often specialists. The inclusion of knowledge of the subject and the procedure as a requisite qualification for the positions recognizes this fact. The resulting preference thereby given an employee of the office in competition

with those outside it, leaves room, moreover, for the deliberate development of the understudy system in management. My own judgment has been that these factors far outweigh any objection that comes from narrowing the competition for a vacancy by demanding knowledge of the subject.

The use of group classes to cover positions that involve like responsibilities and duties, but call for a knowledge of different subjects or procedures, is feasible only if the decision is reached not to differentiate in salary on the basis of the subject or procedure known, provided these factors call for approximately equivalent training, experience, and ability. Persons familiar with the government service as it exists today are aware that a decision not to differentiate on this basis represents a radical reform. In certain fields of statistical investigation and research, the government is a monopolistic employer. Nobody is competing with the government for men to conduct nation-wide censuses of population, nor is the competition keen for men trained in vital statistics or educational statistics. On the other hand, the government has had to meet serious competition for men trained in the field of commercial statistics. Partly because of this competition, partly because of the difference between lump sum and statutory rolls, and partly because of differences in the market when the positions were established, great inequalities in salaries have arisen, and a chief statistician in a field where the government is a monopolistic employer has had to rest content with a salary much less than that being paid to chief statisticians in competitive fields. As an almost inevitable consequence, the younger men who are in a position to change more easily are turning toward the better paid fields, and one can perhaps properly question where the government is to get its future broad-guaged men for its monopolistic positions, in spite of the fact that some of these offices afford an almost unique opportunity for public service.

The commission met this situation by a decision not to let the degree of outside competition or the size of outside salaries be the determining factor. It placed scientific and technical positions regarded as demanding men of equal training and experience on a like salary scale and would pay its vital statisticians salaries equal to those paid its commercial statisticians. In view of this decision group classes could be used.

Another significant feature of the classification of statistical scientists is that both research statisticians and administrative statisticians are placed in the same class. The qualifications for Senior statisticians, for example, contain the following alternative requirement: "successful experience in the organization and management of important statistical inquiries and investigations, including the determina-

tion of the scope of the inquiry, the content of tables, the methods of analysis, and the preparation of reports, or distinction achieved in independent research in the subject to be investigated, or in closely related subjects, as shown by writings and publications and reviews of them."

Conceivably, the time may come when the number of statisticians is so great that the government will be able to secure, for those important statistical undertakings which involve administration, persons who are at once both good administrators and research statisticians of distinction. For the present, the wiser course seemed to be not to establish classes for these super-men of the profession, but to give equal recognition to those who can qualify under either one of the two branches. At present, the large statistical projects of the government must be organized about the available men; and he who is strong on one side and weak on the other must be buttressed on his weak side by capable assistants. The important thing now is to prevent administrative statistical positions from being filled by persons who are not statisticians at all.

The titles of the different classes recommended by the commission, with the salaries it would pay, are given in the following table. The detailed specifications descriptive of the duties, qualifications, and lines of advancement extend from pages 815 to 831, inclusive, of the commission's report and are, therefore, too long for reproduction here.

The position of director of the census and the class of positions entitled Senior Statistician, it will be noted, carry three asterisks in place of a recommended salary. The three asterisks indicate that the rate of compensation shall be "recommended to Congress by the Civil Service Commission after consultation with the heads of departments or independent establishments concerned. The recommendation shall be based upon a full appraisal of the duties and responsibilities of the position and its relation to positions in similar classes; the rate of compensation in each such case to be determined by Congress."

The commission appreciated the fact that in these highest positions the man makes the job. Inferentially, the lowest salary for a Senior Statistician would be over $5,040, since the general rule of the commission was to make the entrance salary higher than the maximum salary for the class below. The commission would perhaps have been willing to fix a minimum, but it was not ready to fix a maximum or to provide for automatic advancement for the highest classes.

The salaries for the statistical science service as a whole are like those recommended for corresponding classes in the other technical and scientific services such as the engineering service, the biological science

Title	*Annual Salary*					
Mechanical Tabulation:						
Assorting Machine Operator	$1140	$1200	$1260	$1320		
Tabulating Machine Operator	1200	1260	1320			
General Tabulating Machine Operator	1560	1620	1680			
Supervisor, Tabulating or Assorting Machine Section (Group)	1560	1620	1680			
Mechanical Tabulation Examiner (Group)	1440	1500	1560			
Supervisor, Mechanical Tabulation Examining Section (Group)	1800	1920	2040	2160		
Principal Mechanical Tabulator	1980	2100	2220	2340		
Chief Mechanical Tabulator	2400	2520	2640	2760		
Card Punch Operator	1200	1260	1320			
Supervisor, Card Punching Section (Group)	1560	1620	1680			
Special Card Punch Operator	1320	1380	1440			
Supervisor, Special Card Punching Section (Group)	1620	1680	1740	1800		
Mechanical Tabulation Coder	1200	1260	1320			
Special Mechanical Tabulation Coder	1320	1380	1440			
Supervisor, Mechanical Tabulation Coding Section (Group)	1560	1620	1680			
Junior Mechanical Tabulation File Clerk	1140	1200	1260			
Supervisor, Mechanical Tabulation File Section	1560	1620	1680			
Special Mechanical Tabulation File Clerk	1320	1380	1440			
Supervisor, Special Mechanical Tabulation File Section	1560	1620	1680			
Statistical Clerical Work:						
Under Statistical Clerk	1260	1320	1380			
Junior Statistical Clerk	1440	1500	1560			
Senior Statistical Clerk (Group)	1620	1680	1740	1800		
Principal Statistical Clerk (Group)	1980	2100	2220	2340		
Head Statistical Clerk (Group)	2400	2520	2640	2760		
Chief Statistical Clerk (Group)	2820	2940	3060			
Statistical Science:						
Junior Statistician	1800	1920	2040	2160		
Assistant Statistician	2400	2520	2640	2760	2880	3000
Associate Statistician	3240	3360	3480	3600	3720	3840
Statistician (Group)	4140	4320	4500	4680	4850	5040
Senior Statistician (Group)	*	*	*			
Director of the Census	*	*	*			

service, the physical science, the economic and political science services, and the social science service.

In general, the salaries for the lowest classes of statistical clerks and employees engaged in mechanical tabulation are apparently higher than those paid by private enterprises. In the classes immediately above, with salaries ranging roughly from $1,500 to $1,800, the difference between the government service and private enterprises in eastern cities is apparently not very great. In the higher classes of statistical clerks and mechanical tabulators, where long experience, knowledge of the subject, and administrative ability are required, the salaries suggested by the commission are considerably lower than those paid commercially.

The salaries for statisticians are more nearly comparable with those paid university professors than with those paid statisticians in the commercial field. In this connection it should be remembered that the government statistician does not work an academic year and that he is

frequently barred from accepting any retainers for special services, and thus cannot add to his income as does a college professor. His writings, moreover, are generally the property of the government and he derives no income from them. In his writings, too, he is restricted by his official position, and although government statisticians and economists frequently are in possession of information which would be of intense popular interest, they not only cannot sell it, but they cannot even make it public. The salaries recommended by the commission, therefore, although representing a material increase over those now being paid, would not put the government statistician on a financial plane of equality with the best paid university professor. The amount of increase, moreover, fails in many cases to offset the increase in the cost of living that has taken place since the positions were filled by the present incumbents, and thus if the salaries are advanced as the commission recommends, the officials will not in fact be as well off as they were when appointed.

The failure to offset the increase in the cost of living is particularly noteworthy in the case of the clerical employees. Prior to the war the popular impression that the government clerks occupying non-administrative positions were generously paid, as compared with those in private enterprises, was undoubtedly correct. The increase in the cost of living has removed this difference, and the recommendations of the commission will not restore it except in the case of the lowest classes of clerical employees. The older government clerks in Washington who were appointed, say prior to 1913, will not find the purchasing power of their salaries fully restored by the recommendations of the commission.

The lowest classes of clerical employees in the government service must necessarily be well paid, as compared with those in private enterprise, as long as Congress maintains the "apportionment" provision of the Civil Service Act. This provision requires that positions in the departmental service at Washington shall be apportioned among the states in accordance with their population. The District of Columbia and the nearby states of Maryland and Virginia have, of course, greatly exceeded their quota, and under normal circumstances a person from one of these states cannot be permanently appointed to an ordinary clerkship. Certain banks and other large corporations have a fixed policy of giving preference to young men, and more especially to young women, who live at home. The government has indirectly adopted a policy exactly the reverse, and almost all its clerical employees must be residing away from their homes. Washington is a city of boarding houses, small apartments, and recently of dormitories. The employee must, therefore, be paid a salary which will permit the maintenance of

this individual status. The government cannot take advantage of the well recognized possibility of securing the lower classes of clerical employees at less than the cost of maintaining a person in the individual status by employing girls and boys who are living with their parents.

The rates recommended by the commission can, of course, be defended on the common argument used to support a minimum wage, but in this case no such defense is necessary, for the government could not attract the kind of people that it requires for its clerkships if it did not pay them enough to maintain themselves in Washington.

These matters that have been discussed are among the more important ones that were before the commission with relation to the statistical employees. In its letter of submittal to Congress the following sentence appears: "The task assigned to your commission by the Congress was the largest of its kind ever undertaken, and your commission is not suffering from any illusions as to the degree of perfection attained." It carried its work to the point which permitted it to lay before Congress a comprehensive plan, sufficiently worked out to warrant the passage of the necessary basic legislation to institute a radical and much needed reform in the government's methods of dealing with its employees. Perfection of detail will have to be secured as the organization develops. With all its possible imperfections of minutiae, the report represents the most important step in advance for the United States Civil Service since the Civil Service Act of 1883.

AN INDEX OF INCOMES

By K. G. Karsten, *New York City*

The purpose of this article is to suggest a set of two index figures or coefficients for the measurement and analysis of income and wealth statistics, which shall, without loss of statistical accuracy, be suitable for popular presentation. One of these coefficients gives a quantitative measurement and may be called an index of the size of incomes; the other is qualitative and may be called an index of the distribution of wealth. Both indices involve what may be called a natural law of incomes, with which, since the work of Pareto,* many statisticians are already acquainted, and of which a short explanation is prefixed.

When statistics of income are plotted upon double-logarithmic paper, that is, upon chart-paper ruled logarithmically on both axes, the resulting curve approaches a straight-line. Before plotting, the data must be cumulated downward, as there are no small frequency intervals of equal geometric distance;† and in this article wherever the figures of income are referred to, it is to be understood that the cumulated and not the individual class figures are meant. The cumulated figures (Tables I and II), representing the number of persons report-

* Vilfredo Pareto, *Cours d'Economie Politique*, Vol. II, pp. 304 *et. seq.*

The present writer unfortunately could not claim acquaintance with the work already done in this field at the time of his investigation and has, therefore, departed slightly from the method of Pareto, without, it must be said, great advantage in such departures. The use of fixation points selected nearer the central portions of the data, has, it is believed, some advantage in the avoidance of possibly artificial deviations at the lower extreme and of chance variations in the small number of quotations at the upper income extreme. The use of fixation points at income levels in the ratio of 10: 1 has the mathematical advantage of the short-cut method noted in the footnote on p. 259.

For graphic presentation, the present writer has finally projected the income levels along the vertical axis, as more readily connoting higher and lower incomes, in spite of the fact that this method projects the unknown variable along the horizontal axis. The so-called "factor of slope" (*S*), from which the index of distribution is derived, is, like the "inclination" used by Pareto, the tangent of the curve with the horizontal axis, but owing to this reversal of axes, is actually the reciprocal of Pareto's measure, that is, it is the co-tangent of the angle measured by him.

† Income statistics need not be cumulated to give the straight logarithmic curve, but the difficulty of showing the great number of small incomes separately makes cumulation convenient. If the statistics are not cumulated, the individual incomes must be thought of as arranged along a base line, or axis, with the largest incomes at one end and the smallest at the other, the remainder ranging themselves between, in succession. The position along the base line or axis must be on the logarithm of the successive number of the incomes; thus the largest income being at the beginning of the base line, the second largest must be at the logarithm of two, the third largest at the logarithm of three, the fourth largest at the logarithm of four, . . . to the smallest income at the logarithm of its successive number (around 100,000,000 in the United States).

All of this is implied in the cumulated figures used in the text; thus, if we have one person with an income of $10,000,000 and two with an income of $5,000,000 or more, the first being already indicated at $10,000,000, the second person has $5,000,000; if we have three persons with $3,333,333 or more, the first two being known, the third has $3,333,333; if we have four persons with $2,500,000 or more, the fourth one has $2,500,000; if we have five with $2,000,000 or more, the fifth has two millions, etc., etc.

TABLE I

CUMULATED INCOME STATISTICS SHOWING NUMBER OF PERSONS WITH INCOMES GREATER THAN EACH INCOME LEVEL. UNITED STATES, 1914

Income Classes (Incomes Between:)	Number of Persons	Cumulation (Incomes of More Than:)	Number of Persons
$1,000,000 and over	60	$1,000,000	60
500,000 to $1,000,000	114	500,000	174
400,000 to 500,000	69	400,000	243
300,000 to 400,000	147	300,000	390
250,000 to 300,000	130	250,000	520
200,000 to 250,000	233	200,000	753
150,000 to 200,000	406	150,000	1,159
100,000 to 150,000	1,189	100,000	2,348
50,000 to 100,000	5,161	50,000	7,509
40,000 to 50,000	3,185	40,000	10,694
30,000 to 40,000	6,008	30,000	16,702
25,000 to 30,000	5,483	25,000	22,185
20,000 to 25,000	8,672	20,000	30,857
15,000 to 20,000	15,790	15,000	46,647
10,000 to 15,000	34,141	10,000	80,788
5,000 to 10,000	127,448	5,000	208,236
4,000 to 5,000	66,525	4,000	274,763
3,000 to 4,000	82,754	3,000	357,515
Total (all classes)	357,515	Total (over $3,000)	357,515

TABLE II

CUMULATED INCOME STATISTICS. UNITED STATES, 1914–1917, WITH PROFESSOR W. I. KING'S ESTIMATE FOR 1910

Income Exceeded	Number of Persons Having Greater Incomes				
	King's Estimate (1910)	From Tax Reports			
		1914	1915	1916	1917
$10,000,000	5	....	....	....	....
5,000,000	15	....	....	10	4
4,000,000	....	....	....	19	12
3,000,000	....	....	....	33	17
2,000,000	56	....	....	67	41
1,500,000	....	....	....	109	74
1,000,000	154	60	120	206	141
500,000	....	174	329	582	456
400,000	....	243	451	827	635
300,000	....	390	705	1,296	1,015
200,000	415	753	1,307	2,449	2,060
150,000	....	1,159	2,031	3,733	3,362
100,000	3,560	2,348	3,824	6,633	6,664
75,000	....	....	5,880	....	....
50,000	15,190	7,509	10,671	17,085	19,103
40,000	22,190	10,694	14,771	22,696	26,190
30,000	34,190	16,702	21,776	32,764	38,923
20,000	54,190	30,857	37,679	53,775	66,300
15,000	....	46,647	54,154	76,396	96,196
10,000	127,190	80,788	88,256	121,701	161,996
8,000	165,190	....	....	157,309	....
6,000	244,190	....	....	....	....
5,000	....	208,236	208,658	272,252	432,662
4,000	449,190	274,763	267,607	344,279	618,467
3,000	720,190	357,515	336,652	429,401	993,425
2,000	1,437,190	....	....	....	1,832,132
1,500	2,702,190	....	....	....	....
1,000	8,543,190	....	....	....	3,472,890
800	13,542,190	....	....	....	....
600	20,657,190	....	....	....	....
400	25,942,190	....	....	....	....
300	27,655,190	....	....	....	....
200	27,925,190	....	....	....	....
100	27,945,190	....	....	....	....

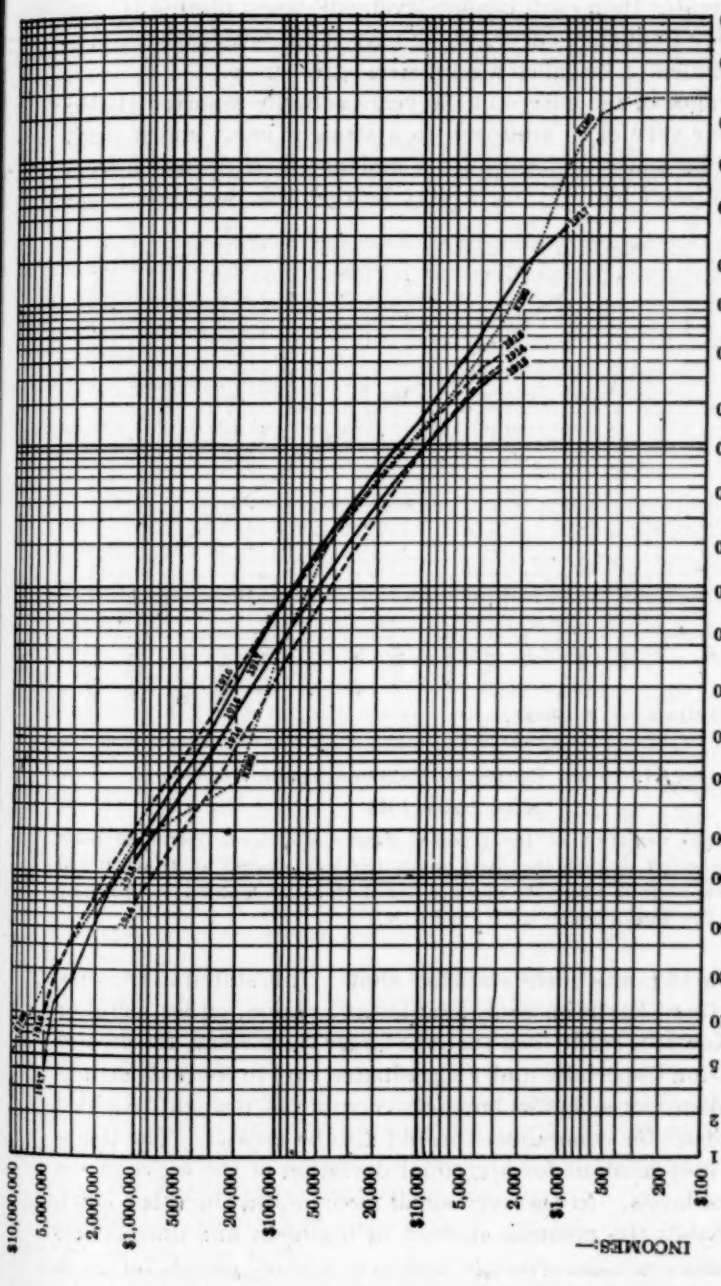


CHART I. GEOMETRIC OGIVE CURVES OF INCOMES
United States, 1910–17

Showing the ogive curves for the various years and for Professor King's estimate (dotted line), plotted upon logarithmic paper, in which the ordinates represent incomes in dollars and the abscissae represent the number of persons reporting more than such incomes.

ing incomes greater than each income-level, will when plotted (Chart I) form an ogive frequency curve, which may, since both axes are projected logarithmically, be called a geometric ogive curve.

The significance of the curves in the years actually reported (1914–17) lies in their very close approach to a straight line,* and it may, therefore, not be amiss to discuss for a moment their deviation from a straight-line (see Chart II); for it may be that this deviation is not

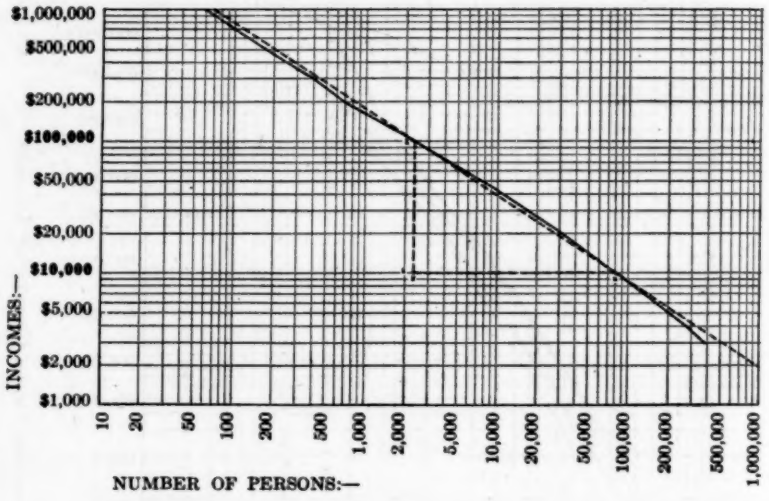


CHART II. NORM PROJECTED THROUGH FIXED POINTS
United States, 1914

Showing the slight deviation of the reported figures (full line), from the norm (dotted line) projected through the fixed points (circles) selected at $100,000 and $10,000. The values from which the index of distribution is computed are shown by the triangle the two legs of which are I/i and n/N.

real, but is due to faults in the statistics alone. It is stated in treasury reports that there has been considerable tax evasion, either wilful or negligent. Now it is easily seen that the larger the income, the greater is the temptation (especially under a graduated tax) to conceal portions of income. Were tax collectors humanly corruptible, it might be added that the facilities for concealment would also be greater. The temptation alone may account for a gradual deviation of the curve in the higher income levels. In the very small incomes, on the other hand, there is probably the greatest amount of negligent and unconscious

* Measured in terms of the tangent of the angle formed by the geometric ogive curve and the ordinates of the paper, the maximum angular deviation of the reported incomes curve from the straight line does not exceed 20 per cent, except at the lower tax limit.

evasion. This includes the farmer who consumes part of the produce of his own farm and makes no report on the produce so used, because no money exchange has taken place to make this a money income.* At the extreme lower tax limit, an abrupt drop in every curve is due to the failure to make any tax report of persons whose incomes are taxable by a small margin only. Operating as these forces do, at different ends, they may be expected to make the curve slightly convex—a form it invariably shows—and the view may be held that the deviations are not true of the phenomena, but are due to the statistical defects.

Obviously, if the true curve be a straight line, it would signify an all-pervasive force or natural law, arranging in strict geometric order or progression the fortunes and possessions of men, and bringing out of the apparent chaos of human society a symmetry and simplicity which is indeed fascinating. This natural law might be phrased as follows: "In any community the number of persons whose incomes exceed any given amount varies inversely and logarithmically with the given amount, modified by a constant factor peculiar to the community." In the constant factor peculiar to the community we should have a coefficient for the community, and although we knew the income distribution through only a small range of incomes, we should be able to unlock the secret of all other incomes in this community.

It is not necessary, however, to adopt the theory that the true curve is a straight line in order to arrive at two useful and significant indices or coefficients for the statistical analysis and comparison of income conditions in various communities. From the simple expedient of a *fitted* straight-line, fitted *at standard and invariable points*, we can derive two such coefficients of ample value in sociological analysis to recommend them in the place of the present lack of relative wealth indices. For although the coefficients will not have definite individual accuracy in themselves alone, yet the variations in these coefficients for different communities, or for the same community at different times, tell a significant story of change in much the same way as relative price figures, derived from a large number of price quotations, tell a story of price changes.

For the sake of simplicity, in this paper two coefficients are suggested and their significance described as though the theory of the straight-line were already an established fact. The attempt is made to insert, from time to time, warnings to the effect that this significance is still theoretical. Even if the curve finally prove to be (when the facts

* Some estimates of the value of produce consumed on the farm compiled from investigation among Wisconsin farmers indicate that as much as 20 per cent of the total expense of the farm is for produce so used. (See Secrist, "Statistics in Business," p. 77.) The necessity of including goods with money in considering true incomes was recognised by Pareto.

about lower incomes are known) not a straight line, it may be that these will remain useful indices, with the possible addition of a third coefficient of deviation. Meanwhile it must always be remembered that the significance of these coefficients in each community really belongs only to the theoretical straight-line community which the actual communities appear most closely to fit.

The selection of the two fixed points upon the actual curve, through which the fitted straight-line is projected (Chart II), is therefore of importance, and it is absolutely necessary that in any given set of coefficients the fixed points be the same for all communities. It is here proposed to set the fixed points where the curve intersects the ordinates of incomes of $10,000 and $100,000. Upon inspection, it will be seen that these parallel closely the general trend of the curve, without venturing too high in the curve where the number of observations (or reports) is small and consequently more subject to chance variations, and without coming into the zone of the more abrupt drop at the bottom of the curve. In certain investigations into the statistics of small parts of the population, it will be necessary to choose fixed points lower on the curve or nearer together, because the number of observations even at $100,000 becomes so small as to be subject to large chance variation; but when this is done the same points in the curve for the entire population should be inspected for their deviation, and the fitted straight-line of the small part of the population should be corrected by this deviation.*

Having fitted a straight line or norm, therefore, at two points, to the curve for any community, the two coefficients for the mathematical expression of this straight line are easily seen. The function of one of these, as already stated, must be quantitative, that is, it must fix the position of the straight line or norm, or of some standard point upon that norm, to the paper, graphically speaking. The function of the other is qualitative; it must define the slope or direction of the norm upon the paper. Let us first consider the latter.

If we define the slope as the tangent of the angle made by the norm and the ordinate or horizontal axis of the paper, we shall see that it may be expressed by the formula:

$$S = \frac{\log I - \log i}{\log n - \log N}$$

when I and i represent the larger and smaller income levels, respectively, at the two fixed points, and N and n represent the number of

* Some inconclusive study of the nature of the trend of the geometric ogive curve would seem to indicate that its changes in slope proceed in more regular intervals when the angle formed at the base is measured by circular measure. As S is the tangent of the angle, correction in the case described in the text should apparently be made after the angles have been from their tangents reduced into degrees.

persons at these levels.* For use as an index or coefficient with popular connotation this factor of slope (S) is, of course, utterly unfitted, involving as it does logarithmic conceptions. Examination will show that the anti-logarithm of S is no more than the ratio between two income levels so chosen that the numbers of persons at these two levels have a ratio of 1:10. Likewise the anti-logarithm of $2S$ would be the ratio between two income levels so chosen that the numbers of persons at these two levels have a ratio of 1:100. In the latter case, if we divided the entire body of persons on the lower income level into groups of 100 persons each, and made the groups as representative† as

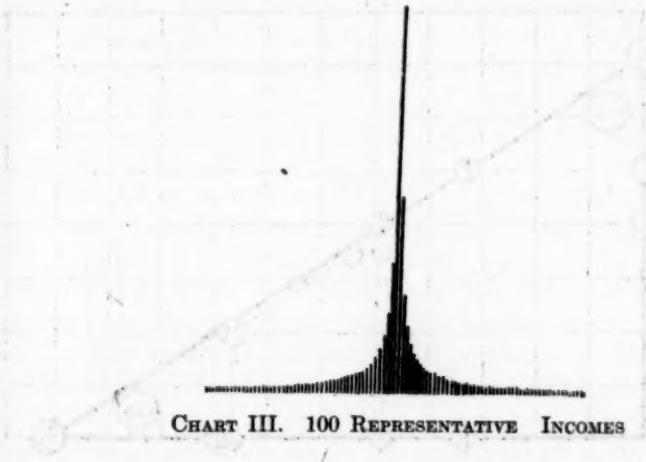


CHART III. 100 REPRESENTATIVE INCOMES

possible in the matter of high and low incomes, then in each such group there would be one person who is also in the higher income level. Or we might say that if we segregated just 1 per cent of the population in such a way that every one in the 1 per cent group had an income greater than any one in the remainder, that is, if we segre-

* A short-cut method can be used if fixed points are always selected at two income levels, one of which is ten times as great as the other. This has been done in the text and in the chart. The result is that the phrase "$\log I - \log i$" or "$\log \frac{I}{i}$" always resolves itself into unity and the formula can be written:

$$S = \frac{1}{\log n - \log N}.$$

† By representative is meant such sampling or selection in the arrangement of the groups, that each group will contain a unit whose ogive curve is identical in slant or slope, with the ogive curve of the entire community. There would then be a considerable uniformity in the matter of the lowest income, but in many groups the highest income would be very great, since at any point along the ogive curve the number of persons plotted includes not only those with the given income, but also those with more than the given income. Hence in these various groups the highest incomes would have many individuals with very large incomes; and the group here called representative is that group (by far the most common) whose wealthiest individual will have only the minimum of the high incomes. The ratio is really between the maximum income exceeded by all of the single wealthiest individuals in the various groups, to the maximum income exceeded by all of the individuals in the same groups.

gated the wealthiest 1 per cent of the population, the anti-logarithm of $2S$ would be the ratio of the minimum income in the wealthiest 1 per cent to the minimum income in the entire population. Here we have a concept which can be grasped by the layman. Roughly speaking, this index of distribution might be defined as "the ratio between the highest and the lowest incomes in a representative group of one hundred persons" (Chart III), or "the ratio of the income exceeded by the wealthiest 1 per cent of the population to the income exceeded by everybody."*

$$\log D = 2S = \frac{2\,(\log I - \log i)}{\log n - \log N}$$

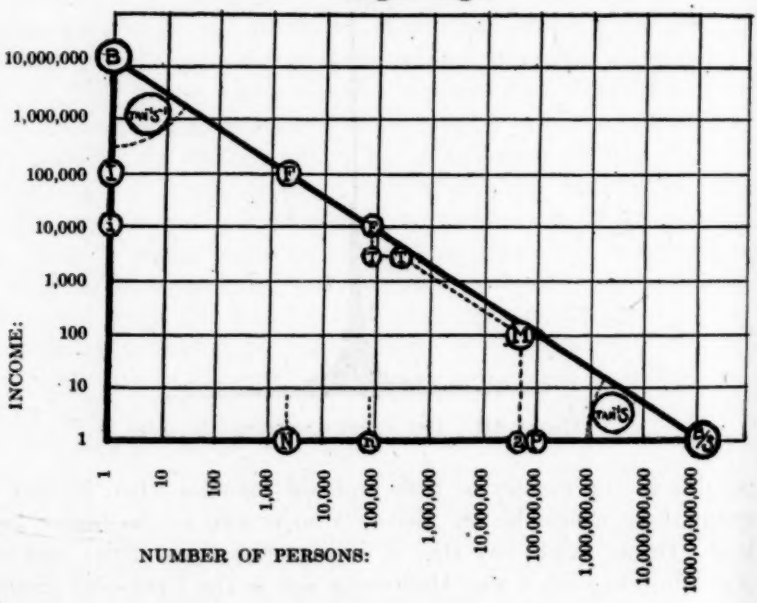


CHART IV. FULLY PROJECTED NORM

United States, 1914

Showing the fitted straight line or "norm" projected through the two fixed points (FF) at the intersections of the two known income levels (Ii) with the two numbers of persons (Nn) having more than these incomes. The line is projected to both axes, showing the bases (B and B/S) at its extremities. The computation of the median (M) is shown, one of the fixed points (F) being corrected for the number of persons represented by each tax-payer (TT) and a parallel to the norm being projected to the abscissa of one half ($\frac{1}{2}$) of the population (P), the intersection of the parallel line (dotted) and this abscissa (dotted) being at the ordinate of the median income (M).

* The trouble with this concept is that the minimum income of the entire population, or the income exceeded by everybody, is entirely theoretical, and takes no account of actual dispersion about the lower end of the norm. As a matter of fact, incomes do not cease suddenly at the lower extremity thereof, but before that point is reached, dispersion sets in and becomes quite marked, carrying a large number of incomes into lower levels, probably in the way of a normal probabilities curve.

Before proceeding to the other coefficient, the index of the quantity of wealth, it is interesting to note that from the formula for S we can derive the income level of any given portion of the population, or the part of the population on any given income level. That is to say, knowing S, i, and n in a community, and writing B for the constant $\log i + S \log n$ in that community, we may find the I for any N or the N for any I in that community, as follows:

$$\log I = B - S \log N \qquad \log N = \frac{B - \log I}{S}$$

Here we have the algebraic expression of the natural law of incomes stated above. Either formula may be traced graphically (Chart IV). The important point is that in either formula, while I and N are variables, there is a phrase which we have called B (in the second B/S) which is constant in the community. In the formula it serves as a base for the equation, in the chart it is seen to be the intersection of the norm with either axis.

In this case (B or B/S) we have the quantitative element in the formula, and it would serve if necessary as the quantitative coefficient. But examination will show that it is the logarithm of the number of dollars income of the wealthiest individual (B) or of the number of persons with incomes greater than one dollar (B/S), and that both numbers are fictitious and theoretical.* Hence not only because of its logarithmic conceptions, but also for its wholly fictitious nature, the base of the formula is not suitable as a coefficient for popular presentation. There is nothing to hinder our taking a point somewhere midway along the curve, however. Many such points suggest themselves, such as the intersection of the curve with the ordinate of $3,000. This would give us the number of taxpayers (in early years) as a quantitative coefficient, which we could read as a percentage of the entire population. Or we can adopt a certain abscissa, representing a certain

* The following definitions may be easily proved from the chart or the formula:

B is the logarithm of the theoretical income of the wealthiest individual in the community, measured in dollars of income, that is, the logarithm of the theoretical maximum income.

$\frac{B}{S}$ is the logarithm of the hypothetical and purely fictitious number of individuals in the community whose incomes exceed one dollar per year, and this number will greatly exceed the actual population of the community, for the reason that incomes do not exist as small as this amount.

S is the logarithm of the number of dollars income exceeded by one individual in every ten individuals, for every dollar of income exceeded by all of the ten; or in other words, the logarithm of the ratio of the two income levels exceeded by the wealthiest and the poorest individuals, respectively, in every ten persons.

$\frac{1}{S}$ is the logarithm of the number of individuals having more than any income, for every one individual having more than an income ten times as great, or in other words, the logarithm of the ratio of the two numbers of persons having more than any two income levels, one of which is ten times as great as the other.

given number of people, or a certain given percentage of the population. It is here proposed to adopt the abscissa of 50 per cent of the population. The constant for each community then will be the ordinate at which the curve intersects this abscissa. In short, it is proposed to use the median income in each community as the quantitative coefficient for that community. Here we have a concept which can be readily grasped by the layman, scarcely any concept would be easier; and yet for statistical purposes it is quite as good as either of the formulary bases, so long as we remember that it is, after all, at present only a coefficient, and does not actually represent dollars and cents of the median income. For at present it is the resultant of a projection of a fitted straight line through two distant points on the curve, which in themselves are only tax reports and subject both to a general upward correction for tax evasion and to a probable error which becomes magnified at the projected point.

It is not so easy to compute the median income from the formulary base $\left(B \text{ or } \frac{B}{S}\right)$ as it was to compute the index of distribution (D) from the factor of slope (S). In the first place, the total population of the community must be known. Where the community is the country or a state, it is not difficult, using estimates from the census. But in other cases, as where the community is an occupational rather than a territorial group, it is often impossible, and no median income can be given for such communities.* When we know the entire population, the question next arises as to how large a part of this population do the taxpayers represent. Obviously we cannot count the tax reports as representing only individuals; on the contrary, they are known to represent families. If we know the size of the average taxpayer's family, we can multiply the known number of persons (n) (representing families), on the known income level (i) to correct for the true number of persons (instead of families) on this level. (Though we have heretofore spoken of them as "persons" in this discussion, they are really families.) The resulting "I" will be the median family income. This assumes, however, that tax-paying families are the same in size as non-tax-paying families—a very questionable assumption. By further correcting the known income-level (i)—that is, dividing this income (I) by the number of persons in the taxpayer's family—we can get the income-level exceeded by the average individual in the

* Where no median income can be found for the entire population in any community or group, because the entire population is not known, it is sometimes useful to have at least a median taxpayer's income (family or individual), but such taxpayer's median, or median of incomes over a certain amount, cannot be used or corrected for use in comparison with medians of the whole population.

tax-paying classes. From this it is a simple matter to apply the formula and get the median individual income.*

In all cases, therefore, it is necessary to know the size of the average taxpayer's family before a median can be reached.† Very definitely here we come to the point of estimates alone. Until 1917, no estimate whatever could be made from the income tax statistics. In that year for the first time personal exemption was allowed to taxpayers according to the number of persons in their immediate family who were supported by them. Hence from the total amount of personal exemption allowed, we may know the number of persons represented by the tax reports. The trouble is that this personal exemption was allowed only for heads of families, husband or wife, and dependent children under sixteen. In 1918 the law was altered to include all absolute dependents, so that not until the returns from 1918 are published, with the amount of personal exemption in that year, shall we have something like the true figure as to the size of the average family. In the meantime, however, the estimated medians, though palpably low, will retain for statistical purposes the full index value of the true medians.

When we come to applying this correction for families to earlier years, we will find that the number of wives, who, though living with their husbands, and part of the same family, make out separate reports from their husbands, varies greatly from year to year. And with any increasing odium which may attach to large incomes, the tendency thus to split up the family income formerly reported in its entirety by the

* The choice between a median family income and a median individual income depends finally upon whether the natural law of incomes (by this is meant the consistent natural forces operating to arrange human incomes into a giant geometric [or logarithmic] pyramid), applies fundamentally to bread-winners only or to all human beings. The considerations advanced below in the text would seem to place all human beings, whether dependent upon bread-winners or dependent upon employers and customers, alike under the operation of any natural law ordering their incomes.

† Two things militate against the use of a family median income. The first is the fact that we cannot entirely identify computed taxpayers' families (computed as in the text following) with the actual taxpayers' families, because in many families some children have independent or partially independent incomes, which prevents any exemption being allowed the head of the family for them. The second is the fact that we have not definite knowledge of the number or size of natural families in the United States, and particularly in the different states. The census lists (in census years) what it calls "artificial families," for the purpose of which neither blood nor marriage ties but common living and eating quarters are the basis of the family (residents at a boarding-house or hotel being counted as members of a single family), with the obviously questionable result that the urban and densely populated districts are credited with larger families than the rural and thinly populated districts.

Probably the most useful estimate of the size of the average American family can be obtained by dividing the total number of persons represented by the taxpayers, by the total number of tax-paying families. The latter (tax-paying families) is, of course, less than the number of tax-paying individuals, for the reason that many wives, though living with their husbands, make out separate tax reports, and it is still less than the number of adults in the tax-paying classes, for the reason that most wives make out no reports at all. According to this estimate, the natural family in 1917 comprised about 3.21 persons each, itemized as follows: "head of family or individuals living alone," average 1 person; "spouse," average .81 person; "dependent children under 18," average 2.40 persons. This statement must be qualified to the extent of its omission of "other dependents," explained in the text.

husband into parts, reported by both husband and wife, will increase. This process, be it remarked, probably had considerable to do with the decrease in the number of millionaire-income families reported from 1916 to 1917, over which so much publicity was stirred. There is, however, a very constant relation, which can hardly change appreciably from year to year, namely, the number of dependents represented per heads of families. Now the numbers of heads of families in the various years can be computed (Table III), and working from that relation we can proceed to estimates of the size of the average taxpayer's family, and from this to estimates of the median income either for families or individuals, remembering that all such estimates will be subject to uniform revision when the 1918 report is published. Method and comparative values will be the same, but the knowledge of the true size of the taxpayer's family will then merely inject a uniform upward correction.

The formula for the median incomes remains the same. In the belief that the median individual income is more valuable for statistical purposes than the median family income, the former is proposed as an index of the amount of wealth, the quantitative index of wealth. This belief is grounded in that fact that whether or not independent

TABLE III

COMPUTATION OF TAX-PAYING POPULATION. UNITED STATES, 1914–1917

NOTE: Figures in **bold-face** are taken from tax-reports, other figures are derived. The tax-paying population and the number of persons in this population per tax-payer (T) are subject to revision from later tax-reports not now available.

				(1917) (over $2000)
Joint returns of husbands and wives and separate returns of husbands				**1,450,723**
Separate returns of wives				**20,530**
Separate returns of husbands				20,530
Joint returns of husbands and wives				1,430,193
Wives not making returns, but represented by joint returns				1,430,193
Total adults making returns				**1,832,133**
Total adult population represented by returns				3,262,325
Total personal exemption claimed			**$3,773,079,800**	
Adult personal exemption (@$1,000 each)			3,262,325,000	
Dependent personal exemption			510,754,800	
Total dependent population under 18 represented (@$200 each)				2,553,774
Total population represented by returns				5,816,099
Returns other than from families containing both husband and wife				**360,879**
Population represented by families containing husband and wife				5,455,220
Number of families containing both husband and wife				**1,450,723**
Persons per full family (containing both husband and wife)				3.76

	(1914)	(1915)	(1916)	(1917)
Returns married	**283,806**	**306,153**		
Wives separate returns	**5,985**	**4,819**		
Married couples	278,821	261,334	**355,107**	**1,450,723**
Persons per married couple	3.76	3.76	3.76	3.76
Population repres. by couple	1,048,250	980,000	1,335,000	5,455,220
Other returns	**74,709**	**70,499**	**74,294**	**360,879**
Total population represented	1,122,959	1,050,499	1,409,294	5,816,099
Total returns (over $2000)	**357,515**	**336,653**	**437,036**	**1,832,133**
T—Pop. repr. per tax-p	3.14	3.12	3.22	3.17

bookkeeping be maintained for each member of the household including dependents, the truth is, strictly speaking, that every human being enjoys the benefits of an income. The view may be taken that dependence itself is really universal whether it be upon heads of families or customers in business. This individual income figure will perhaps correlate better with cost of living statistics, bank deposits, mortality, and other sociological data.

The median individual income can be found from the formula:

$$\log M = \log \frac{i}{T} - S\left(\log \frac{P}{2\,Tn}\right)$$

where P and T represent respectively the entire population and the ratio of the population in the tax-paying classes to the number of tax

TABLE IV

COMPUTATION OF THE INDICES. UNITED STATES, 1914

NOTE: The total population has been diminished by the tax-exempt population (Indians) to get the net population (P). The number of persons per tax-payer (T) is subject to revision from later tax-reports.

Item	Process	Sign	Anti-logarithm	Log.	Loglog.
Returns over $10,000	Cumulation	n	80,788	4.9073	
Returns over 100,000	Cumulation	N	2,348	3.3707	
Log n/N	Subtr. log.			1.5366	.1866
Log I/i	Constant				.0000
S	Subtr. loglog	S		.6507	.8134-1
Distribution Index	Double log.	D	20.02	1.3014	
Returns over $10,000		n		4.9073	
Persons per tax-payer	Computed	T	3.14	.4971	
2		2		.3010	
2Tn	Add. log.			5.7054	
Population total	Census		99,414,340		
Indians (tax-exempt)	Census		335,998		
Population nett	Subtract	P	99,078,342	7.9960	
Log P/2Tn	Subtr. log.			2.2906	.3599
S		S			.8134-1
S(Log P/2Tn)	Add loglog.			1.4903	.1733
T		T		.4971	
Log T* S(log P/2Tn)	Add log.			1.9874	
Income of $10,000	Constant	i		4.0000	
Index of Size	Subtr. log.	M	102.95	2.0126	

reports. The median individual income can be used in the formulae for finding unknown incomes by substituting for B, the phrase: $\log M + \log \frac{P}{2}$, remembering that by so doing the reading of N has been changed from families to individuals by the correction for T. In the table (Table IV) the computation of both the coefficients is shown in detail.*

* It is not deemed necessary to point out in the text that in computations of the median, the total population must be corrected to the total population from which taxpayers are drawn. Thus tax exempt groups, such as the American Indians, must be deducted.

It will be seen that the computed median for the whole United States in 1914 was little more than one hundred dollars. Professor King's estimate for 1910 was $800 per family, or about $175 per individual. Surely the median income did not fall so greatly during the interval. The explanation may lie in tax evasion and consequently incomplete reports which are the basis of the 1914 computed median. It may lie partly in the 1910 estimate. It may lie in the theory of the straight line, about which many statisticians are in doubt, and which can only be settled by a complete array of reliable figures in all income classes. It illustrates quite clearly, however, what has been already repeated, that the median computed from present tax reports cannot be taken as an actual measure of dollars and cents. Whatever value it may have at present is limited to use as an index figure in comparing different communities. Nor, with greatly changing efficiency in tax-collection methods, and some changes in tax-computing and tabulating methods, does it greatly interest us to know that the computed median for 1917 is 11 per cent higher than for 1914, for the entire United States. Its present use, even as a coefficient, is probably limited to comparisons of different parts of the country at the same time (Chart VI).

It is probably true that there are a number of real reasons for a lower actual median in the country than is generally supposed. For we must remember that the individual median is not the income which half the families exceed, nor half the bread-winners, nor half the adults; but it is the income which half of the entire population exceeds, and half falls short of. It takes into account, therefore, the actual income of children, babies, the sick, and public charges and dependents of all kinds. Many of these incomes are never thought of as individual incomes, but are covered in the bookkeeping of those upon whom the individuals are dependent. Nevertheless, it is an open question whether the incomes are not still as real in the last analysis as if separate accounts were maintained for each. But we must be prepared to meet with median income figures much lower than wages, possibly lower than cost-of-living standards. How much does the average child in a poor farming district live on, when in New York City, where probably twice as high a percentage of the population pay income taxes as in other parts of the country, the recent survey of the Board of Health shows 20 per cent of the school children suffering from malnutrition.

But whatever real causes there may be for a low median, there are artificial or statistical causes which definitely prevent the computed median (M) from being at present anything more than a statistical coefficient. Let us briefly review these causes. The computed median

is the mathematical result of projecting downward to 50 per cent of the population, a straight line which has been fitted to two points arbitrarily selected in the curve of the known income statistics which cover only 5 per cent of the population. Before this computed median can be taken as connoting a real sum of money, three hypotheses must be established: (a) That the curve of income statistics is really a straight line throughout all classes of society; (b) that the two points arbitrarily selected really lie in this straight line; and (c) that the number of dependents per taxpayers has been correctly computed. Until the straight line theory has been accepted in full the first of these hypotheses is in doubt. The second is openly untenable (the most that we can hope for being that the two points lie parallel to the true line) on account of tax evasion. The third admittedly awaits correction from figures compiled under the 1918 tax law and not yet available.*

Every care should, therefore, be taken not to use the present computed median as an actual sum in dollars and cents, but only as a statistical coefficient. For this purpose it is best used in terms of percentages of the average median or of some base reduced to 100 per cent (Chart VI). In such a use the variations in the computed medians, which would result from shifting the arbitrarily selected points through which the straight line is projected, lose importance, since if only the same points are used throughout all communities compared, the relative percentage of each will be about the same, regardless of the location of the points. And even as a coefficient alone, the computed median, or index of the amount of wealth, is subject to so large a probable error, owing to tax evasion, tax collection methods, and tax-computing and tabulating changes, that it certainly cannot yet be used for comparison between different years to much advantage and has only a questionable value in the comparison of different communities for the same year (Chart VI). It has been proposed here in the belief that in the course of time it will be possible to depend more fully upon the median income for quantitative wealth analysis, and that in the meantime there is need for some quantitative as well as a qualitative coefficient in the analysis of the present income statistics.

* The correction in the estimates of the taxpayer's family, which can be expected within another year, on the basis of fuller data as to dependents, will probably not increase the estimates from the present 2.4 persons to more than 3 persons per family. A common habit in American statistics has been to use the census "artificial family" figures of 4.5 persons per family (*cf.* footnote on p. 263). Let us assume, however, that the average American economic or natural family consists of 4.5 persons, in and out of tax-paying classes alike. Let us also assume that the tax collectors have reached only half of the wealth of the taxpayers; in other words, that tax evasion amounted to 100 per cent of the taxes reported. Both of these assumptions are in the nature of maximum possible errors. In the first case, a median income of $200 would be corrected to $175, and in the second case to $400, and in both cases at the same time, to $350.

The significance of this coefficient, in so far as it has any at present, may be illustrated as follows: Where one state shows a larger median than another, we may conclude that the majority of the population is wealthier in the first than in the second state. The median, therefore, indicates the degree of wealth or poverty of the great mass of the people in any community.* And so, according to this index, we can judge the condition of the masses in different states and communities, and in that sense can classify the communities themselves as "rich," average, and "poor" (Chart VI). It need not be added that to turn a coefficient of money wealth into a coefficient of real purchasing-power, the price-changes must also be considered.

It remains to make clear the significance of the other coefficient, the index of the distribution of wealth, which has been already computed. It is for sociological purposes far the more important of the two and, apart from the doubt attaching to the straight-line theory, and some smaller probable error due to tax evasion, is free of the weaknesses of the quantitative coefficient (the computed median). It has been roughly defined as the ratio of the highest and lowest incomes in each average or representative sample group of one hundred persons (or families) in the community. It denotes the geometric progression in which incomes increase in size as they decrease in number. Thus where the index of distribution is 60, there will be one individual with more than $60,000 a year for every hundred with more than $1,000; there will be one individual with more than $600,000 for every hundred with more than $10,000; and so on throughout the community's range of incomes. An increase in the index will mean a higher income for the one individual; a lower index, a lower income for him. So a disproportionate rise in the fortunes of the few or a disproportionate fall in the fortunes of the many, will be reflected in a higher index of distribution; and vice versa, a disproportionate fall in the fortunes of the few or rise in the fortunes of the many will be reflected in a lower index of distribution.

It is not the actual wealth of the people measured in dollars and cents, nor even in terms of price changes, which determines their buying power in the long run so much as the relation of their wealth to the wealth of others in the same community. Prices themselves appear

* Were it possible to obtain the average per capita income, the latter might be advanced in place of the median as a coefficient of wealth. Habit has already gone far to establish the per capita wealth (not merely income) as such a coefficient. But it is submitted that while the simplicity of the computation of the mathematical (or arithmetical) average has much to recommend it, the latter figure has not an iota of the significance which attaches to the median in this connection. Commonly the median has not been obtainable, because the distribution of incomes was lacking. When it can even be estimated, it is believed that its wealth of human significance places it easily above the arithmetical average in usefulness.

to be affected, not alone by the general wealth but also by this comparative or relative distribution. The trend of modern economics is placing ever greater importance upon this comparative consuming power of the different members of the community, and attributing to it an influence upon the general level of prices and indeed upon the entire trend of productivity in the community. Into the effects of the injection of many relatively large incomes into a community, upon prices in that community, and upon the shifting of production objectives from the so-called necessities to the so-called luxuries, it is not the province of this discussion to go; but it must be seen that it is precisely the extent of such injection of relatively large incomes of which the index of distribution is a measure.

It may even be argued that the index of distribution is the measure of the good or bad health, economically speaking, of income and wealth conditions in a community; that its variations reveal more truly than other indices the actual changes of distribution in all that relates to incomes and earning power, and to a considerable degree serve to mark the even less tangible forces of human happiness, citizenship, and both producing and consuming powers of the individual. We tread here upon ground so delicate that any heavy pressure of the point will break through completely, and the utmost that can be defended in such a general interpretation is that the index of distribution, *ceteris equibus*, records a very vital and sensitive factor in the shifting conditions of human life.

To be specific, let us assume two extreme conditions of society, the one where wealth is equally enjoyed by all, and the other where one individual owns and enjoys all the wealth of the community. Such conditions are purely hypothetical, but for lack of a better phraseology the one may be described as communistic and the other as economically monocratic. In these communities, the index of distribution would be, in the first case, unity, in the second infinity. Between these two extremes we may take as a mid-way community one in which the number and sizes of incomes exceeded would vary inversely,* and the index of distribution would be 100.

What is the significance of this mid-way community? Perhaps it can be illustrated briefly by assuming that we wish to sell in this community an article which every one who can will purchase, but will purchase only once. In the mid-way community, it makes no difference what price we set, our gross sales will amount to the same sum.

* In such a community the second richest person would have an income of one-half the income of the richest person, the third richest person would have one-third, the fourth would have one-fourth, and so on down to the one-hundred-millionth person, who would have but one one-hundredth-millionth of the income of the richest individual.

For in this community, for each and every person having a hundred dollars to spend, there are five persons having $20 each, ten persons with $10 each, and one hundred who have one dollar to spend. Whether our price be one dollar or a million dollars, we shall have the same gross receipts from sales. But as the index falls below 100, our potential market is greater if a lower price be set; when the index is greater than 100, our potential market is larger if the price is raised. Of course, in actual cases many other factors would enter into buying motives and price fixing. The case is here put only to illustrate a balance in the mid-way community.

Adopting this mid-way community whose index is 100, therefore, as a turning point between two conditions in which the wealth of the many poorer or the few richer predominates, we find ourselves at a loss for words with which to describe the significance of the two conditions. It may be observed that in a more democratic distribution of wealth the index will be lower, while in a more plutocratic distribution the index will be higher, and that to either trend the response of the index is immediate. Exception may be taken to the use of the over-worked words "democratic" and "plutocratic" in this connection, but the present writer can find no others which carry the connotation. Without wishing to abuse the meaning of these words, they are offered as the best translation of the two vitally significant conditions described. Where the index is less than one hundred, the community would then be described as economically more "democratic" than "plutocratic"; where the index is more than one hundred, the community would be called economically more "plutocratic" than "democratic"; and in comparing different communities by the index of distribution of wealth, we could classify them—always remembering the inadequacy of the words—as economically "democratic," average, or "plutocratic."*

The trend of the United States in the last four years in which statistics are available, as shown by this index of the distribution of wealth, is extremely interesting (Table V). It will be seen that throughout the early period of the European war the rise of the fortunes of the few was rapid and the conditions of wealth distribution were leaving a point of great economic "democracy" and rapidly approaching a point of economic "plutocracy." We see that in 1917, upon the entrance of this country into the war, this course was halted and a slight return toward "democracy" set in. The cause of this reversal of trend may

* For certain statistical purposes the weakness of any arithmetical relative index applies to the index of distribution, in that changes of similar character are more exaggerated in amount in the large indices than in the small ones, precisely as happens in relative price indices which are measured arithmetically. If the logarithm of the indices (of distribution) be used, the changes will be marked more evenly. Or if the index of distribution is plotted on logarithmic paper the same result is reached. Either step is virtually the adoption of the factor of slope (S) from which the index of distribution (D) was computed.

perhaps be found in the governmental interference and price-fixing which accompanied the conduct of the war. If so, the measure of government control experienced by this country was extremely bene-

TABLE V
INDEX OF DISTRIBUTION OF WEALTH. UNITED STATES, 1914–1917

Year	Index (D)
1914	20.02
1915	29.31
1916	38.26
1917	27.75

ficial to the great majority of the population for at least the time being. The movement of the index of wealth distribution in later years as figures become available from the tax collector's office, will be of great interest in showing how permanent or temporary was this trend away from "economic plutocracy."

An interesting comparison can also be made with the countries included in Pareto's survey. In the table (Table VI) the conditions noted by him are set forth, after translation into the index here

TABLE VI
DISTRIBUTION OF WEALTH ABROAD. (PARETO, "COURS D'ECONOMIE POLITIQUE")

Country	Province	City	Urban or Rural	Year	Index of Distribution (D)
France	....	Paris (rents)	Urban		18.8
England	....	....	Total	1843	21.5
				1880	30.3
Germany	....	Augsburg	Urban	1471	25.0
				1498	22.9
				1512	38.8
				1526	59.4
	Saxony	....	Total	1880	18.4
				1886	21.1
	Prussia	....	Total	1852	11.4
				1876	14.6
				1881	14.3
				1886	15.5
				1890	17.8
				1894	17.8
Italy	Anconia, Arrezzo, Parma and Pisa		Urban		32.7
	Florence		Urban		26.2
	Perugia	....	Urban		15.3
			Rural		28.8
	....	Misc. cities	Urban		24.0
Switzerland	Basle		?	1887	41.0
Peru	....	....	Total	ca. 1800	13.1

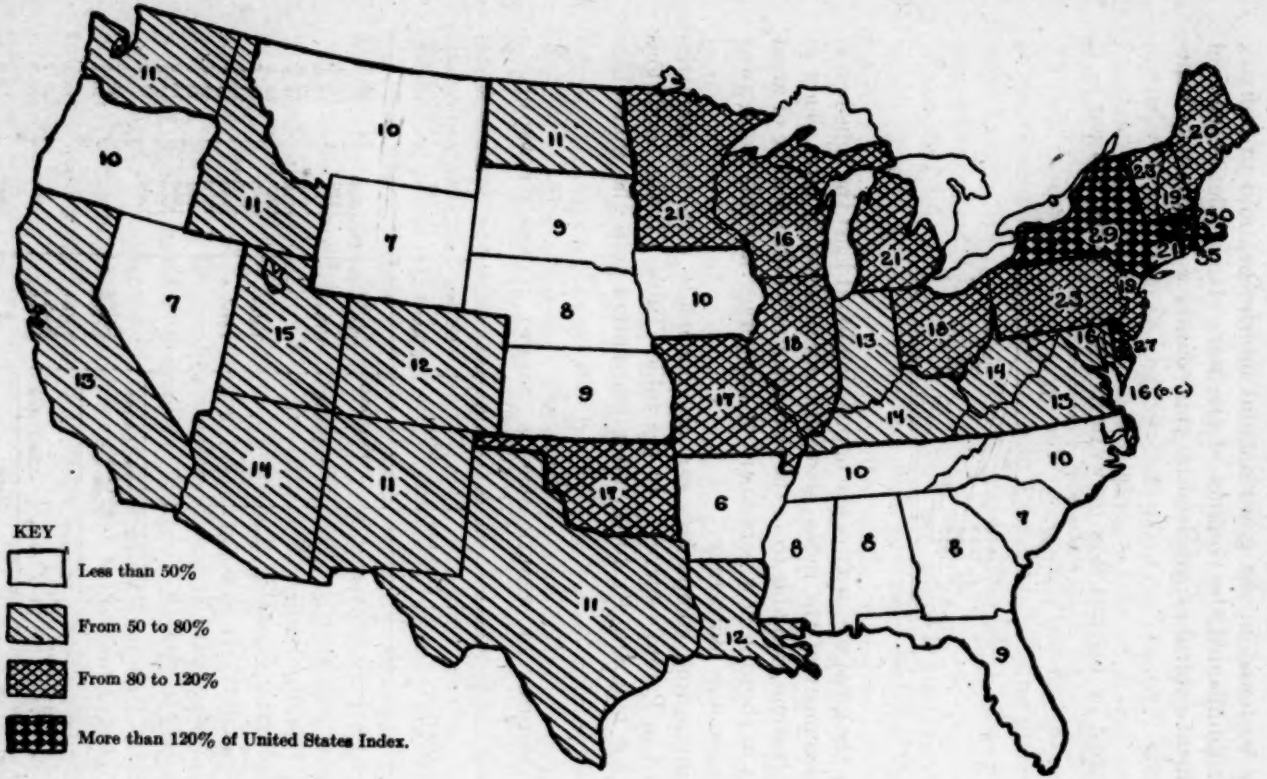


CHART V. DISTRIBUTION OF WEALTH
United States, 1914
(United States Index—20)

adopted.* The history of the city of Augsburg in the fifteenth and sixteenth centuries is extremely significant of social conditions in a decadent community drifting from democracy to plutocracy. The same trend, less marked, is evident in the Prussian figures.

Another interesting use of the index may be made from the detailed statistics of income prepared by the government in 1916 (Table VII)

TABLE VII

DISTRIBUTION OF WEALTH BY OCCUPATIONS. UNITED STATES, 1916

Occupations	Index	Occupations	Index
Total (All groups)	38.3	Business Group (*continued*)	
Professional Group	15.0	Production	61.3
Professions proper	14.1	Agriculture	18.8
Military	7.6	Lumber-owners	30.1
Public service—civil	11.5	Mine-owners and operators	217.5
Law	22.9	Manufacturers	93.6
Clergy	9.2	Distribution	29.6
Medical	7.7	Merchants and dealers	34.3
Teaching	8.3	Travelling salesmen	6.9
Fine arts	18.5	Catering	14.8
Writing	17.7	Hotel owners, etc.	13.1
Stage and music	31.4	Saloon keepers	8.5
Art and sculpture	13.2	Sportsmen, turfmen, etc.	9.3
Architects	15.3	Theater owners	39.0
Technical	14.7	Other business	35.2
Engineering	16.9	Business not stated	56.2
Accounting	10.1	Financial Group	83.2
Other professions	20.6	Bankers	89.1
Profession not stated	17.6	Insurance brokers	22.6
Business Group	31.2	Insurance agents, etc.	11.8
General	18.9	Real estate brokers	19.3
Corporation officials	29.6	Stock & bond brokers	595.0
Other office employees	18.3	Other brokers	76.3
Laborers	12.3	Investors and speculators	95.6

in which occupational analysis was made. It will surprise few to find the professions so very much more "democratic," economically speaking, than the business or capitalistic occupations.

A geographical analysis of the distribution of wealth cannot be so accurately made from the reports, for reasons connected with the method of reporting,† but in spite of its greater margin of error, such

* Pareto's measure was the tangent of the angle formed by the fitted straight line to the axis on which the incomes were plotted. As explained in the footnote on p. 253, this is the reciprocal of the factor of slope (S) here used. So that the index of distribution quoted in the table is simply the anti-logarithm of twice the reciprocal of his measures.

† "Income reported by an individual or corporation in one state may have been derived from sources in other states." (Statistics of Income, 1916, p. 12.) Hence the figures show geographical distribution of receipt of incomes, but not of source of incomes. A subsequent statement, that "for the collection of tax at the source the collecting agent filed the return in the state in which the agent was located, regardless of the residence of the person earning this income," applies only to corporate returns, not to personal returns, since payments of tax at source are credited to individuals wherever they reside.

The year 1916 is exceptional in income statistics, and not really to be compared with other years, for the reason of a change in reporting adopted in that year only. This change, introducing a statistical difficulty which can hardly be overcome, is as follows: If A and B, married—husband and wife—filed separate reports, A for $10,000 and B for $5,000, they were entered in the final report in 1914, 1915, and 1917 as two returns of $10,000 and $5,000 each, but in 1916 they were entered as one return of $15,000, and in the occupational analysis of 1916 they were entered as two returns of $15,000 each.

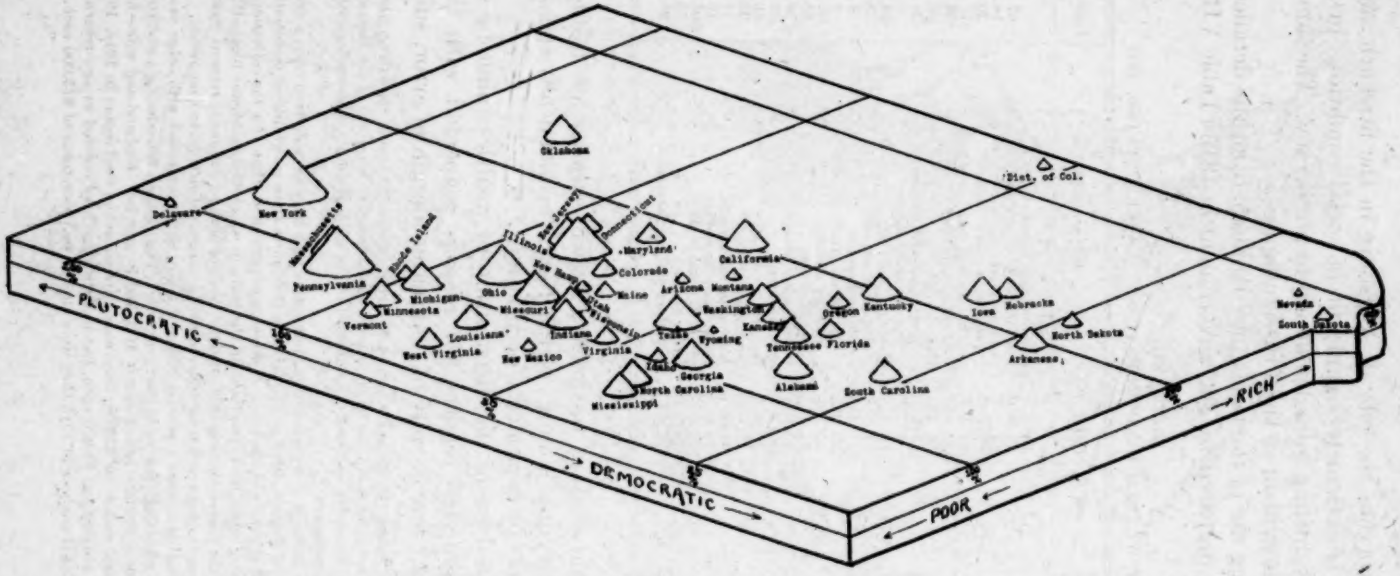


CHART VI. WEALTH CONDITIONS IN VARIOUS STATES

United States, 1916

Showing each state as a cone, of which the area of the base represents the population of the state, and the position upon the two axes, the two indices of wealth (index of size and index of distribution) of the state as compared to the two indices for the entire United States (U. S. = 100% on both axes). It should be observed that the indices for Nevada and South Dakota are based upon such scant returns as to make them quite unreliable, and their extreme position has little significance. The difference between urban populations and total urban and rural populations is perhaps illustrated by the position of the District of Columbia.

an analysis is of great interest (Chart V). Note for example that the entire south, where the median income is low, and the wheat belt, where it is high, both show a very "democratic" structure. Delaware, Rhode Island, Massachusetts, and New York are extremely "plutocratic." Iowa, a farming state of very high median income, where the number of automobiles per capita is largest, has a low index of distribution, while Oklahoma, also an agricultural state, but rich in mineral resources, has a high index.

Instances of the use of this index could be multiplied greatly, as also of the use of the quantitative index, but it is believed that the foregoing sufficiently illustrate the method. In conclusion, we may say that the two indices or coefficients here suggested for the measurement of income conditions, rest upon the following steps:

(a) Statistics of income are cumulated downward to show the number of persons having more than each amount of income.

(b) The cumulated statistics are plotted upon double-logarithmic paper and a straight line is fitted to their curve at two points arbitrarily selected.

(c) The two points are selected arbitrarily at the intersection of the curve and the ordinates of the incomes of ten thousand and one hundred thousand dollars.

(d) At the intersection of the projected straight line and the abscissa of half of the population, after the necessary corrections for the size of tax-paying families, the indicated median individual income is read from the ordinate at this intersection and is taken as an index or coefficient of the size of incomes in the community.

(e) The tangent of the angle made by the fitted straight line and the base or horizontal axis of the paper, upon which the number of persons has been projected, is taken as one-half of the logarithm of the index or coefficient of the distribution of wealth.

By the use of these two indices we can expect to classify communities as relatively "rich" or "poor" and (economically or financially) "democratic" or "plutocratic" (always understanding these expressions in the limited sense above detailed). We can look for communities of four classes, namely: "rich and democratic," "rich and plutocratic," "poor and democratic," and "poor and plutocratic"; in short we may have every combination of the two conditions in every degree (Chart VI).* And the great interest will not lie so much in the deter-

* A useful study would consist of the collection of the two indices for a large number of groups of the population with the idea of finding any degree of correlation which may exist between the two. *Prima facie* there would appear to be none, and it is, of course, true that any statistical correlation based upon medians which are not fairly reliable may be attributed to statistical errors (for the index of distribution enters into the projection downward to the median, and is, therefore, a component part of the

mination of these conditions at any given point of time, as in the discovery of the nature of the changes in these conditions in the community or communities, from time to time. For society is rarely static; it is normally dynamic, and the chief problem of interest is where, when, and how it is moving.

median). But some preliminary examination seems to indicate a rather large degree of correlation, whereby the larger the index of distribution the smaller the median income. This will be seen in the chart (Chart VI) where most of the states are grouped in a broad zone running diagonally across the board. If such a correlation can be established, the significance is very great, as it will mean a sweeping revision of our present basis of judging prosperity. That is to say, if it can be proved that, using the terminology of the text, "plutocratic" communities are normally "poor" and "democratic" communities are normally "rich," it means that as the volume of visible wealth owned by the very rich members of the community grows larger and larger, the condition of the great mass of people in that community is not improving, but is deteriorating, and great wealth will in itself become one of the signs of such deterioration.

A GRAPHIC METHOD FOR PRESENTING COMPARATIVE COST ANALYSES

By H. R. Bonner, *United States Bureau of Education*

Considerable demand has arisen for a method of unit cost analysis which will show graphically just how much money is being spent for various purposes and whether such expenditures are proportionately high or low. The following article presents such a method for analyzing and interpreting the expenditures incurred by nine state normal schools. The applicability of the plan outlined is not limited, however, to the educational field alone, but is equally adaptable to other activities where the expenditures of several plants or systems of any type are to be compared.

LIMITING THE STUDY

These nine state normal schools have been chosen for study from a list of 58 such schools submitting similar reports to the Bureau of Education for 1917–18, because they vary considerably in size and possess wide deviation from the general practice in the distribution of their costs among the generally recognized functions of expense. Only nine schools have been chosen, since they serve to illustrate this graphic method of presentation and the principles involved therein, and since it is not the purpose of this article to furnish a complete analysis of such statistics of all normal schools. The content of the subject has been sacrificed, therefore, for the sake of simplicity in presentation.

TABLE I—TOTAL CURRENT EXPENSES IN NINE STATE NORMAL SCHOOLS, 1917–18

Code number of school	Attendance weeks	Total current expenses	Cost of administration	Cost of instruction	Cost of operation of plant	Cost of maintenance	Miscellaneous costs
1	2	3	4	5	6	7	8
9	1,558	$28,437	$2,640	$16,360	$3,606	$2,102	$3,729
7	8,766	90,325	8,692	54,906	19,059	812	6,856
5	15,243	122,777	9,000	30,113	16,455	61,656	5,553
4	15,909	110,741	5,113	31,882	29,743	40,201	3,802
6	9,618	59,541	7,286	34,364	16,499	492	900
2	28,344	165,645	6,794	38,998	71,495	44,237	4,121
1	39,116	191,780	13,642	142,683	20,030	8,425	7,000
3	17,577	68,966	5,700	48,790	11,704	1,622	1,150
8	6,805	15,444	2,330	9,298	3,816	.....	.....
Totals	142,936	$853,656	$61,197	$407,394	$192,407	$159,547	$33,111
Average cost (per student per week)	.....	$5.97	$0.43	$2.85	$1.35	$1.11	$0.23
Per cent of total	.....	.....	7.2	47.7	22.6	18.6	3.9

SIGNIFICANCE OF THE CODE NUMBER

Each school in Table I has been assigned a significant number which indicates the relative size of the institution as measured in attendance weeks. Thus, school No. 1 is the largest, having a total of 39,116 student or attendance weeks, and school No. 9 the smallest, with only 1,558 similar units. In ascertaining the number of attendance weeks, the attendance of one student for one week at the school is considered a unit. If a student attends for 36 weeks or one year, the institution is accredited with 36 student weeks or attendance weeks. If a student withdraws from school after attending for six weeks, the school is given credit for only six attendance weeks. Students in extension and correspondence courses have been omitted from consideration. Thus, each school is measured by the same unit, thereby permitting a just and fair comparison of expenditures.

ACCOUNTING TERMINOLOGY

In order that a comparison of expenditures may be justly made, it is necessary to eliminate from the field of study all unusual expenditures. Consequently, all capital outlays for new buildings, grounds, and new equipment have been excluded, and only those expenditures have been included which are likely to be constant from year to year and which are usually termed *current expenses*. It would be unfair to include *capital outlays* since possibly only one school in the nine would have spent any considerable sum for the construction of a new building during the year. Such unusual expenditures, which are designed to serve for a period of years to come, must be eliminated from consideration in such a study of annual expenditures. Consequently only *current expenses* are analyzed. This major classification includes the costs of *administration*, of *instruction*, of *operation of plant*, of *maintenance*, and of *miscellaneous* items. The cost of *administration* usually includes the salaries and expenses of the president or principal and of the controlling or governing board. The cost of *instruction* includes the salaries of deans and teachers, the cost of text-books and any amount spent for supplies (materials which when used are of no further value) used in instruction or in the actual teaching process. Under *operation of plant* are placed the wages of janitors, firemen, and engineers; the cost of fuel, water, light, and power; and the supplies used in keeping the school plant fit for occupancy. *Maintenance* costs include expenditures for repair work and for the replacement of outworn furniture, apparatus, etc. *Miscellaneous* costs constitute a catch-all group which includes the cost of medical inspection, transportation of pupils, school libraries, lunches, lecture courses, rent, insurance, contributions, and a host of other

auxiliary agencies. Great variation from the general practice, therefore, may be expected among the schools on this score. In Table I the total current expenses were classified and distributed by each school under these five subdivisions.

THE AVERAGE AND THE MIDDLE HALF

In this method of cost analysis, the arithmetical average is used as a basis with which to compare the total current expenses and also the various subdivisions of this total. It is found to possess a certain mathematical property not characteristic of the median, as will be shown below.* Even with so small a number of schools as nine, the median and the average are not materially different. Although the median is not used, its near relatives the first and third quartiles have been utilized to mark the boundaries beyond which it is questionable for an institution to transgress. A sort of hybrid has, therefore, been introduced—the middle half or "safety zone" and the average. These "safety" and "danger" zones have been indicated clearly in the accompanying figures on three different counts.

It has become almost an established practice, especially in the analysis of school costs, to divide the school systems studied into four equal or nearly equal groups, according to the magnitude of the unit cost. Schools having expenditures falling within the upper or lower fourths are usually considered as having high or low costs. The schools falling within the middle half of the array are within the so-called "safety zone." The extreme costs may be more or less justifiable if all the conditions were known, but ordinarily such justification does not exist. It might be contended that all high unit costs are commendable in view of the fact that such a meagre amount is often spent on education. It should also be borne in mind that small schools usually have comparatively high unit costs. A reduction in cost might mean the discontinuation of the institution.

THE AVERAGE COSTS

In Table I the average costs for the nine normal schools combined have been secured by dividing the respective total costs by the total number of attendance weeks. It is found that the average cost per attendance week for all purposes is $5.97. This average implies that it costs $5.97 to maintain a normal school for a week for each student in attendance. Of this amount, 43 cents goes for administration, $2.85 for instruction, $1.35 for the operation of plant, $1.11 for maintenance costs; and 23 cents for miscellaneous purposes. Thus, 7.2

*See Bulletin No. 81, 1919, Bureau of Education, by Blauch and Bonner.

per cent of the total cost in the "average" school goes for general control, 47.7 per cent for instruction, 22.6 per cent for operation, 18.6 per cent for maintenance, and 3.9 per cent for other purposes. These averages and percentages form the bases with which the practice of individual institutions is compared. Each school contributes its weight to the "make up" of these basal figures.

THE INDIVIDUAL COSTS

The average cost per attendance week has been computed for each institution and the results placed in Table II, in columns 2, 4, 9, 14, 19, and 24. The corresponding averages for all schools combined have been carried forward from the preceding table and placed in the proper columns in the same table. In school No. 9, the total cost per attendance week is $18.25. Of this amount, $1.69 is spent for administration, $10.50 for instruction, $2.31 for operation, $1.35 for maintenance, and $2.40 for miscellaneous purposes. These amounts are respectively 9.3, 57.6, 12.6, 7.4, and 13.1 per cents of the total, $18.25. These proportional percentages are shown respectively in columns 8, 13, 18, 23, and 28 of the table.

THE TOTAL COST CURVE

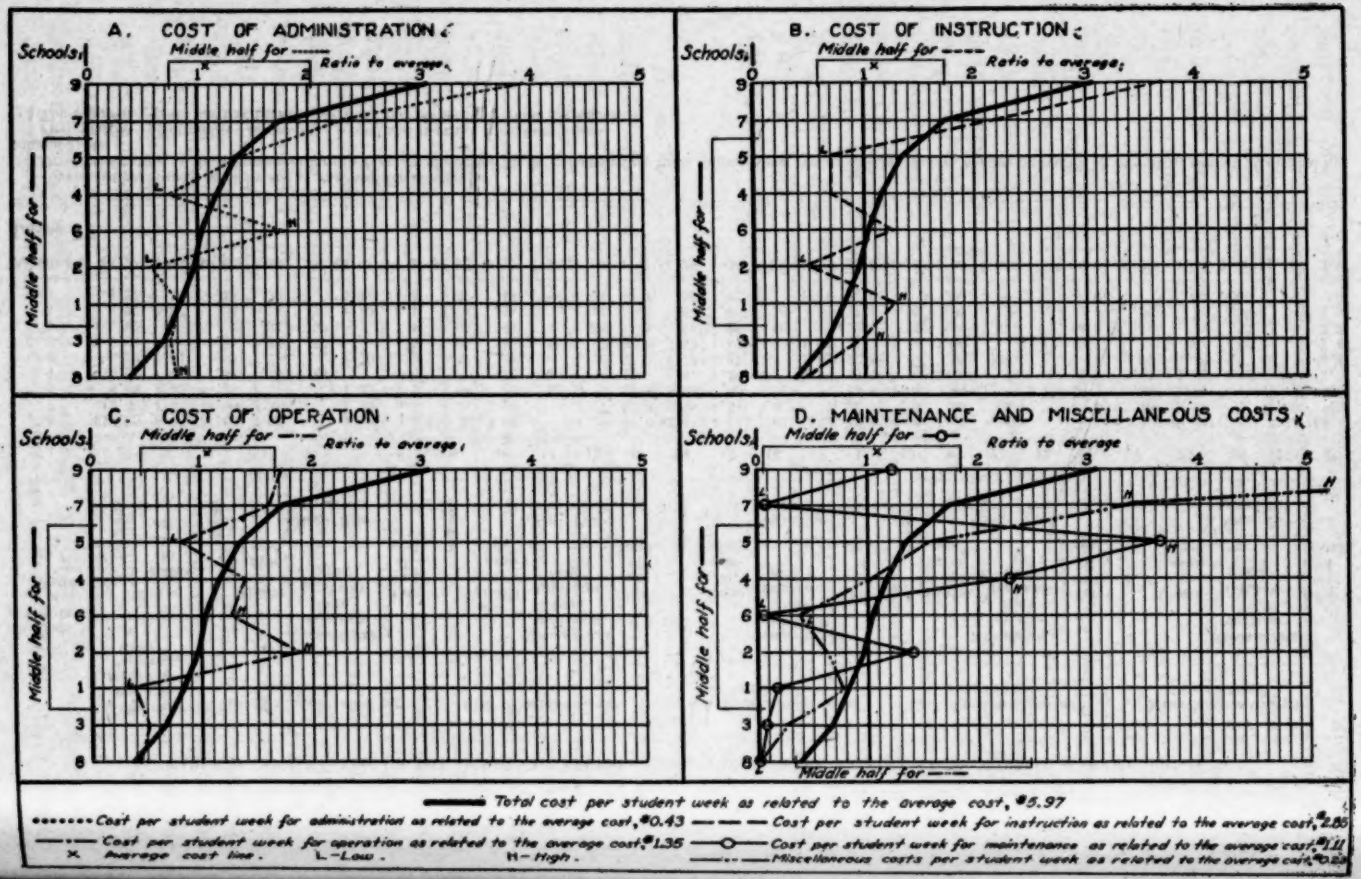
The costs in each institution and in all schools combined have been reduced to a uniform basis, *viz.*, the cost per student week. The relationship of this weekly cost in each school is now compared with the average cost in all schools. The order in which the schools appear in both the tables and the graphs is determined by the magnitude of this cost per attendance week as shown in Table II, column 2, and by the continuous heavy curve in the diagrams. In school No. 9, the cost is $18.25 or 3.06 times the average cost of $5.97. In other words, the cost per student week in school No. 9 is over three times the average cost. This ratio is placed in Table II, column 3, and is used in locating the first point on the heavy curve in the charts. As this ratio indicates the deviation from the general practice geometrically, instead of arithmetically, it is best termed the *ratio of geometrical deviation.*

In two ways at least this ratio is superior to the arithmetical deviation so frequently found. For instance, the arithmetical deviation of the total cost in school No. 9 from the average cost is +$12.28. The corresponding deviation of school No. 8 from this average is −$3.70. The significance of these differences is not easily grasped. The first denotes that school No. 9 is higher than the average by $12.28, and that school No. 8 is lower than the average by $3.70. But neither shows what proportional reduction or increase is necessary to effect a com-

TABLE II—AN ANALYSIS OF THE CURRENT EXPENSES PER STUDENT WEEK IN NINE STATE NORMAL SCHOOLS, 1917-18

Code number of school	Total current expenses per "student week"		Cost of administration per "student week"					Cost of instruction per "student week"					Cost of operation of plant per "student week"					Cost of maintenance per "student week"					Miscellaneous cost per "student week"				
	Amount	Ratio to average*	Amount	Ratio to average*	Geometrical deviation from total cost ratio†		Per cent of total	Amount	Ratio to average*	Geometrical deviation from total cost ratio†		Per cent of total	Amount	Ratio to average*	Geometrical deviation from total cost ratio.†		Per cent of total	Amount	Ratio to average*	Geometrical deviation from total cost ratio†		Per cent of total	Amount	Ratio to average*	Geometrical deviation from total cost ratio†		Per cent of total
					Negative	Positive				Negative	Positive				Negative	Positive				Negative	Positive				Negative	Positive	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
9	$18.25	3.06	$1.69	3.93	.....	1.28	9.3	$10.50	3.69	.....	1.21	57.6	$2.31	1.71	.66	.....	12.6	$1.35	1.22	.40	.....	7.4	$2.40	10.44	.....	3.41	13.1
7	10.30	1.73	.99	2.30	.....	1.33	9.6	6.26	2.20	.....	1.27	60.8	2.18	1.61	.93	.....	21.1	.09	.08	.05	.....	.9	.78	3.39	.....	1.96	7.6
5	8.05	1.35	.59	1.37	.....	1.02	7.3	1.98	.70	.52	.....	24.6	1.08	.80	.59	.....	13.4	4.04	3.64	.....	2.70	50.2	.36	1.56	.....	1.16	4.5
4	6.96	1.17	.32	.74	.63	.....	4.6	2.00	.70	.60	.....	28.7	1.87	1.39	.....	1.19	26.9	2.53	2.28	.....	1.95	36.3	.24	1.04	.89	.....	3.5
6	6.19	1.04	.76	1.77	.....	1.70	12.3	3.57	1.25	.....	1.20	57.7	1.72	1.27	.....	1.22	27.8	.05	.05	.05	.....	.8	.09	.39	.37	.....	1.4
2	5.84	.98	.24	.56	.57	.....	4.1	1.38	.49	.50	.....	23.6	2.52	1.87	.....	1.91	43.2	1.56	1.40	.....	1.43	26.7	.14	.61	.62	.....	2.4
1	4.90	.82	.35	.81	.99	.....	7.1	3.65	1.28	.....	1.56	74.5	.51	.38	.46	.....	10.4	.21	.19	.23	.....	4.3	.18	.78	.95	.....	3.7
3	3.92	.67	.32	.74	.....	1.10	8.1	2.78	.98	.....	1.46	71.0	.67	.50	.75	.....	17.1	.09	.08	.12	.....	2.3	.06	.26	.39	.....	1.5
8	2.27	.38	.34	.79	.....	2.08	15.0	1.37	.48	.....	1.21	60.4	.56	.42	.....	1.11	24.6	.....	.00	.00	.....	.0	.....	.00	.00	.....	.0
All schools	$5.97	1.00	$0.43	1.00	‡.81	$1.51	7.2	$2.85	1.00	‡.56	§1.38	47.7	$1.35	1.00	‡.62	§1.20	22.6	$1.11	1.00	‡.05	§1.69	18.6	$0.23	1.00	‡.38	§1.56	3.9
Legend		——		----					---					—·—					—o—					----			

* Divide cost per student week by the average cost for all schools.
† Divide the ratios to the average cost for any function of expense by the corresponding ratio for the total cost in column 3, *i. e.*, column 5 divided by column 3; column 10 divided by column 3; etc.
‡ First quartile—point midway between the second and the third lowest deviations.
§ Third quartile—point midway between the third and the second highest deviations.


A. COST OF ADMINISTRATION
B. COST OF INSTRUCTION
C. COST OF OPERATION
D. MAINTENANCE AND MISCELLANEOUS COSTS
Schools
Middle half for
Ratio to average
Total cost per student week as related to the average cost, $5.97
Cost per student week for administration as related to the average cost, $0.43
Cost per student week for instruction as related to the average cost, $2.85
Cost per student week for operation as related to the average cost, $1.35
Cost per student week for maintenance as related to the average cost, $0.11
Miscellaneous costs per student week as related to the average cost, $0.23
Average cost line.
L-Low.
H-High.

mendable practice. To arrive at this conception, a ratio of geometrical deviation must be resorted to, *viz.*, divide $12.28 by $18.25 to ascertain the percentage of reduction necessary in school No. 9, or divide $3.70 by $2.27 to get the percentage of increase necessary for school No. 8 to approach the average. By reference to column 3 of the table, it is seen at once that the first school spends 3.06 times the average, and the second only .38 of the average. The points are clearly shown in the charts as the extreme points of the continuous heavy curve.

In further disapproval of the arithmetical deviation in studies of this type, it may be said that when it is used only one curve may be drawn on a diagram unless a double scale is used. In plotting curves of ratios of geometrical deviation, everything relates to the average, which becomes 100 per cent or 1 as shown in the diagrams.

In this study it is found that schools No. 9 and No. 7 lie in the highest and schools No. 8 and No. 3 in the lowest fourth, which are "danger zones." The more general practice is indicated for the other five schools bracketed at the extreme left of each diagram. The schools falling within the middle half and the relative variation of the total cost per student week in each school from the average cost for all schools, are readily apparent from the diagrams.

THE ADMINISTRATION COST CURVE

In a similar way the deviations of the costs for administration in the various schools from the average cost have been computed as shown in columns 4 and 5 of Table II and the corresponding ratios plotted in Figure 1, Part A. To read this curve, observe that school No. 9 spends 3.93 times as much per student week for administration as is spent on an average school, No. 2 spends .56 of the average amount, while school No. 5 spends 1.37 times the average amount of 43 cents. Schools Nos. 9 and 7 spend the largest amounts, and schools Nos. 4, 2, 3, the smallest amounts and lie respectively on this score in the upper and lower fourths. The other four schools on the cost for administration lie within the middle half and have been so indicated by the bracket at the top of the chart. From this curve, therefore, it is possible to read from the same chart as that containing the total cost curve, the relative amount spent for administration as compared with the average amount so expended. In each case the "danger zones" and "safety zones" have been indicated.

THE OTHER CURVES

The ratios of geometrical deviation for the costs of instruction, operation, maintenance, and miscellaneous purposes have been com-

puted in the same manner as the corresponding ratio for administration costs and the respective results tabulated in columns 10, 15, 20, and 25 of Table II, and used in locating the "zigzag" curves in parts B, C, and D of the graph. As these curves are interpreted in the same manner as that for administration on Part A, a discussion of them is unnecessary. In case two such curves are placed on the same figure, as in Part D, the middle-half zone for each may be indicated at the top and at the bottom of the chart.

THE RELATIONSHIP OF ANY CURVE TO THE TOTAL COST CURVE

A comparison between the total cost curve and any curve representing a function of expense for any institution gives the proportion going for that function as it is related to the average proportion for all schools combined going for the same purpose. Thus, in Part A, it is seen that the cost of administration in school No. 9 is 3.93 times the average cost of 43 cents, and that the total cost is 3.06 times the average total cost of $5.97. If the first ratio (3.93) is divided by the second (3.06), the quotient thus obtained (1.28) shows that the proportion going for administration in that institution is 28 per cent higher than the average. Such quotients have been termed *geometrical deviations from the total cost ratio* and are shown in Table II in paired columns, 6 and 7, 11 and 12, 16 and 17, 21 and 22, and 26 and 27. The first column of each pair contains those deviations which are less than unity, and the second column those which are in excess of unity, and they are called negative and positive deviations respectively. It is seen, therefore, in the diagram (Part A), that the proportion spent for administration is higher than the average in schools Nos. 9, 7, 5, 6, 3, and 8, and lower than the average in schools Nos. 4, 2, and 1. Schools Nos. 5, 1, and 3 spend about the average proportion. If all schools spent the average proportion, *viz.*, 7.2 per cent as shown in Table I, the dotted curve would coincide throughout with the total cost curve. The percentage variations from the heavy continuous curve indicate the magnitude of the deviations from the average practice.

It now becomes necessary to show that the *geometrical deviations from the total cost* curve express correctly the magnitude of the deviations as measured in the usual way, *viz.*, by computing the proportion of the total cost in each school going for the various functions of expense and comparing the ratios thus obtained with the corresponding average ratio for all schools combined. By referring again to Table II, it will be noted that the $18.25 spent by school No. 9 is distributed as follows: $1.69, or 9.3 per cent, for administration; $10.50, or 57.6 per cent, for instruction; $2.31, or 12.6 per cent, for operation; $1.35, or

7.4 per cent, for maintenance; and $2.40, or 13.1 per cent, for miscellaneous costs. The average percentage spent for administration is 7.2, while the percentage so spent by school No. 9 is 9.3. It is evident that this school spends $\frac{9.3}{7.2}$ times the average. This ratio without question measures the geometrical magnitude of the deviation of this school's expenditures from the general practice. Therefore $r=\frac{9.3}{7.2}$. In determining this particular relationship from the graph we have assumed that $r=\frac{3.93}{3.06}$. If our assumption is correct, the first fraction equals the second, or

$$\frac{9.3}{7.2}=\frac{3.93}{3.06}.$$

If the amounts from which these four relationships were derived in Table II are substituted for them, the verification of the equality is at once apparent.

$$9.3=\frac{\$1.69}{\$18.25},\quad 7.2=\frac{\$0.43}{\$5.97},$$

$$3.93=\frac{\$1.69}{\$0.43},\quad 3.06=\frac{\$18.25}{\$5.97};$$

or substituting in the equation above,

$$\frac{\frac{\$1.69}{\$18.25}}{\frac{\$0.43}{\$5.97}}=\frac{\frac{\$1.69}{\$0.43}}{\frac{\$18.25}{\$5.97}}$$

or

$$\frac{\$1.69\times\$5.97}{\$18.25\times\$0.43}=\frac{\$1.69\times\$5.97}{\$0.43\times\$18.25}$$

or

$$1=1.$$

Thus it is shown that the ratios used in interpreting the graphs are equal in magnitude to the ratios usually employed in showing such relationships. It is unnecessary, therefore, to compute the percentage distribution of expenditures for each institution or even for all schools combined, as such comparisons are readily apparent from the graphs. For practical purposes it is not necessary to compute the percentages given in Table II, columns 8, 13, 18, 23, and 28. It has now been definitely shown that when the supplementary curves fall to the right of the total cost curve the proportion is higher than the average pro-

portion so expended, and when such curves fall to the left of the total cost curve the proportion is lower than the average proportion.

THE SAFETY ZONE FOR PROPORTIONAL DISTRIBUTION

Conditions may make it undesirable for a school to lower its total cost per student week, but a readjustment of the distribution of costs may be feasible. Thus, it may not be possible for school No. 9 to lower its average cost of $18.25 per attendance week, since the school is very small, having only 1,558 attendance weeks during the year, and since the cost per student must remain necessarily high. The school also is located in a state where the winter is long and fuel costs are high.

The question, therefore, of a readjustment of expenditures is the only way in which the institution can conveniently conform to the more general practice of normal schools. The question now is: Does the school spend too high a proportion for administration as measured by middle practices? As previously pointed out, it spends 1.28 times the average proportion spent by all nine schools. Does this ratio fall within the "safety zone?" Upon examining column 7, Table II, it is found that three schools have greater percentage deviations than this, *viz.*, in school No. 8, 2.08; in school No. 6, 1.70; and in school No. 7, 1.33. Since there are nine schools in the list, the two having the highest ratios are placed in the upper fourth. These facts have been indicated on the diagram (Part A) by the letter "H" denoting "high." Upon examining column 6 of the same table, it will be noted that schools Nos. 4 and 2 expend the lowest proportions for administration and have been placed accordingly in the first fourth and marked "L" denoting "low." These facts indicate that the proportion spent for administration (1.28) by school No. 9, although considerably higher than the average (1), is still within the "safety zone." The limits of the middle half have been chosen half way between the second and the third highest and between the second and third lowest schools, and have been inserted in Table II, at the bottom of columns 6 and 7. Thus, on administrative costs a school may vary from .81 to 1.51 in its deviation from the total cost curve without being subjected to derogatory criticism. Corresponding actual and permissible deviations have been ascertained for the other functions of expense as shown in the paired columns 11 and 12, 16 and 17, 21 and 22, and 26 and 27 of the same table. For the sake of economy in printing, positive and negative deviations may be placed in one column. In the same manner, as explained above for "administrative" deviations, the "danger zones" for the other functions of expense have been marked "H" (high) and "L" (low).

WHERE TO BEGIN A CHANGE IN THE DISTRIBUTION OF COSTS

By observing all parts of the diagram simultaneously, it will be noted that school No. 9 spends relatively high proportions for administration, for instruction, and for miscellaneous costs, and relatively low proportions for operation and maintenance. Other things being equal, it should first reduce its miscellaneous costs, since on this score it falls decidedly within the upper "danger zone" (10.44). To come within zonal bounds this ratio must be reduced to at least 1.56. The next place to effect a reduction is in the cost of administration, since this curve (Part A) intersects the line representing school No. 9 at 3.93, while the instruction cost curve (Part B) intersects it at 3.69, indicating that the proportion spent for general control is relatively higher than that spent for teaching purposes. If this school must run at its present cost per student week ($18.25), it may be necessary to increase the proportion spent for maintenance, as this institution now spends its smallest proportion for this purpose as judged by the average proportion spent for this function by all schools. An inspection of the school plant may reveal the fact that repair and replacement work is badly needed. It may be that janitors are underpaid and that the proportion allotted for operation should be increased.

It can be seen from the graph that school No. 9 has a very high total unit cost ($18.25)—so high that a justification of it is rather difficult to make. No other school spends so large an amount. Why is it necessary to triple the cost of schooling to secure the advantage of a small institution? For administration this school spends almost four times as much as it costs in the "average" school. Possibly the principal receives a high salary, or perhaps the board of directors is well paid. The curves clearly show where the investigation of school costs should begin, if they have been correctly classified and reported. What causes the unusual expenditures for miscellaneous purposes? On this score only does this school fail to make a defendable distribution of costs, since it is the only point for this school marked "H" or "L." On maintenance costs this institution falls within the "safety zone," spending only 1.22 times the average for all nine schools.

In a similar manner the finances of the other institutions may be analyzed and questioned.

It is the duty of the statistician to lay the facts bare and to point out relationships as has been done in these diagrams; it is the function of an administrator or school surveyor to make suggestions for modifying the practice exposed or to justify the expenditures incurred.

It should be remarked that greater deviation from the general practice usually prevails where the function of expense is small, and

less deviation where the function is large: thus on the cost of instruction it is not the common practice to spend less than .59 or more than 1.74 of the average as indicated by the upper middle-half zone in Part B, while for miscellaneous purposes the permissible range varies from .43 to 2.47 as shown by the lower middle-half zone on Part D. The same statement holds for the variation of the proportional amounts so spent. Thus, for instruction, a school may deviate from the total cost ratio only to the extent of .56 and 1.36, while for maintenance costs the corresponding permissible deviations range from .38 to 1.56.

With these explanations clearly in mind, it is seen that a multiplicity of relationships is unfolded in the diagrams. Two further comparisons also may be made. The costs in one school may be compared directly with the costs in another school by disregarding the average costs and middle halves indicated. For instance, school No. 7 spends more than school No. 2 per student week. In the former school, both the absolute amount and the proportional amount spent for administration per attendance week is greater than the corresponding costs in the latter. For the costs of operation of plant, the relative magnitude of these costs is reversed, school No. 2 spending more than school No. 7.

In case it is desirable to compare the costs in a school not represented in the graph with the costs in the nine schools chosen for this study, it is necessary only to ascertain the total cost and the cost for each function of expense per attendance week and to divide these quotients by the average costs for the nine schools represented. The costs in the additional school are then superimposed on the graphs—the total cost per attendance week in the school determining its position. Thus, if the total cost per week is found to be $10.00, a new "school" line would have to be drawn between school No. 7 and school No. 5 on each diagram. An added space can easily be conceived, but it is not necessary to an interpretation of relationships. The supplementary curves, representing administration, instruction, etc., would be "broken" between schools Nos. 7 and 5 to lead to and from the new point thus added to each part of the figure. The only disadvantage incident to such an addition is that the costs in the new school do not operate in determining the averages or the middle halves. If a sufficiently large number of instances are incorporated in the original drawings, the modification accompanying the addition of a single new school would not ordinarily materially affect the predetermined standards. In fact, it is often desirable to compare a school system or an institution with some related standard of which it is not a part.

THE MEASUREMENT OF LABOR PRODUCTIVITY

By P. Sargant Florence, *Bureau of Industrial Research*

Within the last five years a mass of writings has accumulated on the subject of labor turnover; more recently, absenteeism in labor has attracted attention and the two subjects have been recognized as closely connected. What has not yet been realized, however, is that parallel with these two "labor losses" goes a third, without which the usual statistical analysis and measurement of the efficiency of the personnel of an industrial plant is entirely lacking in final development. I refer to the possibility of an unduly low productivity on the part of the employee even when he is not "turning over" and not absent.

Probably this neglect of the final stage in ensuring personnel efficiency is due simply to the difficulty of measuring the degrees of loss involved. Labor turnover rates for the whole plant are now expressed in percentages of the average working force, and the hours lost by absenteeism are also quoted for the whole plant as a percentage of the total scheduled hours; but how can the actual degree of productivity in a multitude of different operations be a percentage of anything, or be quoted for a whole plant?

The question obviously is up to the statistician and until he solves the matter only the fringe of labor loss measurement is touched. For what is the use of a stable working force attending regularly if, possibly through very "staleness," the productivity of the individual man is low?

As in the case of labor turnover and absence, it is essential for the statistician to summarize the unit facts of any plant, or department, or operation, in such a way that the general showing of different plants, or different departments within a plant, or the different operations within a department can be compared fairly one with another. In fact, a coefficient is required of which the *numerator* gives the shortcoming of the actual showing from the maximum showing considered possible and of which the *denominator* gives some definite measure of such possibilities. Each plant or department or single operation is thus judged by the deviation from the possibilities of its own situation.

In the case of labor turnover, the coefficient adopted has as its numerator the annual number of men leaving or the annual number of men replaced (there are two rival schools of thought) and as its denominator the average working force during the year. In the case of absence the numerator is the number of man-hours lost and the denominator the

total possible number of man-hours that could be worked according to schedule.

It is clear that the measure of absence is of the two the truer form of coefficient. The denominator gives the absolute possibilities which the numerator cannot exceed. In other words, the ratio can never have a greater value than 1, or 100 per cent. Moreover, the measure of *efficiency* (the attendance record) and the measure of *deficiency* (the absence record) are convertible, the one into the other. If Ab is the absence man-hours, and At the man-hours attended, and P the possible man-hours scheduled, $P = Ab$ plus At, and the absence coefficient $\frac{Ab}{P}$ can be derived from $\frac{P-At}{P}$.

The denominator of the turnover coefficient, on the other hand, gives only a rough indication of the absolute possibilities. We might assume that it was impossible for the whole working force of a plant to leave its employment more than once a day, supposing payment to be on a day-basis, not hourly. In that case the maximum possibility of turnover per year, assuming 300 working days per year, would be 300 times the working force, and the actual showing could be correctly expressed as a percentage of this. The average turnover has been found by the old method to have been in recent years around 200 per cent; stated as suggested, this would be equivalent to a coefficient of .66 per cent.

A Low Productivity Coefficient

Leaving aside the possible legitimization of the turnover coefficient on the lines of the absence coefficient, it is important that any *low productivity* coefficient that we may devise should start life in the right way. The possibilities of the situation in the matter of productivity (PP) must be known, and if the actual productivity (AP) is known, the coefficient of low productivity $\frac{LP}{PP}$ should be equivalent to $\frac{PP-AP}{PP}$ or $1-\frac{AP}{PP}$.

How is the ratio of productivity $\frac{AP}{PP}$ to be found?

The objective unit in which productivity is measurable directly is the output; its quantity as so many identical pieces per hour, or if the work is not "repetitive" as a speed of so many minutes per job; and its quality as so much scrap per hundred pieces, or so many minutes wasted per hour.

Output is definitely recorded in industrial plants as part of the ordinary routine for the following purposes among others: to watch carefully the routing of the work, to ensure work up to specification, to determine the amount of the piece-wages to be paid, and also as a pure measure of the efficiency of the individual employees even when these are on a time wage.*

These records of productivity, whether quantity or quality of output is in question, may be placed as follows in ascending order of detail:

1. Records of the productivity per day of a gang† or squad of men on the same operation. We shall refer to these as group-day records.
2. Records of the productivity per day of individual men. We shall refer to these as man-day records.
3. Records of the productivity per hour of a squad or gang of men. We shall refer to these as group-hour records.
4. Records of the productivity per hour of individual men. We shall refer to these as man-hour records.

Records of types 1 and 2 are a usual part of plant bookkeeping, though the records are often destroyed after the lapse of three or four weeks. Records of type 3 are usually kept whenever scientific management has proceeded as far as the installing of a planning department, in order to schedule the routing and to follow the progress of the work. Records of type 4 are quite unusual as yet, and have to be specially demanded. Their collection, however, requires no disturbance of factory routine.

Certain indirect measures of productivity can also be used: for quantity of output the consumption of power in driving the machines, for quality of output the relative number of accidents. The consumption of power, be it noticed, only measures the output on machine work, while an accident, though undoubtedly the child of error in attention and faulty muscular coördination, just as is spoiled work, is by no means its twin brother.

The numerator of the ratio of productivity being manifest directly or indirectly in the actual showing of amount of output, speed of output, proportion of scrap, waste time and even consumption of power and accidents, how is the denominator indicating the degree of lowness of the productivity to be found? The word "low" gives us the clue. Lowness is a comparative word. The productivity must be low compared to productivity similarly manifested, but under other circum-

* H. L. Gantt writes: "If the conditions are such that we can plan out the work ahead of time, we will get a fair degree of efficiency by keeping individual records of the workmen and raising their day rate accordingly. As a matter of fact, a better efficiency can be obtained by this method than by the ordinary system of piece work, where the rates are set by past records or the estimates of the foreman."

† "Gang" is used to denote several men coöperating or combining on the same job; "squad" to denote several men working singly on similar jobs.

stances, and it is precisely some other "standard" production that must serve as our denominator.

How can a standard productivity be obtained?

Scientific management's time study will probably suggest itself immediately. Here is precisely a study whose main object is to find a humanly possible speed of operation that shall be a standard on which to calculate routing schedules, costs, and the piece rates premiums, or bonuses that are paid to the worker. The actual output is usually compared with this standard and a percentage efficiency worked out giving us, apparently, exactly the ratio of productivity we require.

But time-study is, so to speak, made *ad hoc*—specifically for one purpose, and it is often conducted only on one or two men during two or three short periods—probably too restricted a sample on which to judge the possible productivity of a whole group of men over their whole working time. The inadequacy of the time study in setting a standard productivity will be evident to practical statisticians when it is considered that those conducting these studies know nothing (or at any rate have published nothing) as to the relative productivity of the individual men and the particular time of day they select as samples, as compared with the possible productivity of the whole group of men and and the whole working period. Time-study men do not seem even to be aware that there is such a thing as a normal curve of error in abilities. To them apparently all men are equal and all times are equal; there is no problem of sampling; the productivity of any man and any time will do to represent the standard productivity of the whole.

It must be conceded that "scientific managers" are vaguely conscious of shortcomings in their method and usually the standard speed set is some 20 per cent below the actual time study results in order to allow for human nature. This allowance saves the system from a *reductio ad absurdum*, but the whole procedure can hardly be called scientific.

It is the aim of the following study to find standards of productivity that are based on a sufficient number of samples and which, especially, are not based on an experiment introducing unusual elements, such as the stop-watch. The sample in fact must be taken from the ordinary plant records that are collected as part of the plant activities.

In fact we must use for our "standard" denominator precisely the same sources of information and the same plant records as we did for our numerator giving the actual showings. But these records—output records at any rate, as we have listed them—are of several different types: group-day records, man-day records, group-hour records, man-hour records. It would obviously be valueless to compare the

productivity of one man or group of men at one time with the productivity of another man or group of men at an entirely different time. The standard productivity must be of the same nature as the actual showing. If we wish to estimate the comparative productivity of different times, we must cite the productivity for different hours or days of the same man or group of men; if we wish to estimate the comparative productivity of different men, we must cite their productivity at one and the same periods of time. We thus reach the conclusion that, in the present state of our knowledge at any rate, the nature of the standard productivity must vary according to the problem we have in mind and the issues involved.

Here we shall confine ourselves to two specific comparisons that are both presenting important issues in industry today:

A. How does a man or a group or a squad of men compare in the various hours of the working day with its own standard for the most productive hour? What is the comparative *hour* productivity?

B. How does any given man's productivity in a squad compare with the productivity of all the men in the squad? What in fact is the *distribution of productivity* among the men in a squad? What is the comparative *man* productivity?

The importance to industry of an answer to question A lies in the problems of the daily cycle of loss of practice and fatigue. Do the earlier and later hours of the day show diminished productivity, and if so, what is the precise diminution say in the first hour, the eighth hour, the tenth hour? Does a ten-hour day pay? What length of working day is it that gives maximum productivity? And so on.

Question B has also certain very practical bearings in industry. Even supposing that one man's or a whole squad's productivity does not vary greatly from hour to hour, it does not follow that productivity is up to standard possibilities. While the course of output is smooth as between hours, the whole general level may be low.

In fact if comparative hour to hour productivity serves us as an index of daily fatigue, a comparison of individuals' general level of productivity probably may serve as an index of a chronic fatigue that is not removed by a night's rest. It may serve to point out easily fatigued individuals—neurasthenics—who would possibly form a class apart on a completely lower level of productivity.*

Further, the measure of comparative man-to-man productivity

* That industry contains enough subnormal individuals to constitute a severe loss is definitely maintained by psychologists and physiologists, as may be seen from Dr. Spaeth's articles in the *Journal of Industrial Hygiene*. Dr. Spaeth even goes so far as to assert that neurasthenics form such a large part in any group of workers that it is impossible to speak of any average typical productivity to include all the men in the group.

may throw light on a somewhat different kind of consideration—the voluntary restriction of output. For how else will this restriction manifest itself than by reducing the individuals most capable of high production to a level of man-productivity lower than their natural capacities would admit?

In the following paragraphs we shall illustrate the methods of computing coefficients of hourly productivity and man-productivity from figures supplied by a recently issued *Bulletin of the United States Public Health Service.** The main purpose of this *Bulletin* is the comparison of the working capacity of the personnel in two plants, one working a ten-hour day, the other an eight-hour day, but both engaged in metal working and both of equal technical efficiency.

Hourly Operation Output

The standard performance for any one operation against which to measure the hourly productivity which was used in the *Public Health Bulletin* was the maximum output shown by any one of the eight or ten working hours of the day as found on a whole squad after at least a week's test.

The following table is drawn directly from the *Bulletin*,† and shows the result of such a test on four "squads," each engaged on a different

TABLE I: COMPARATIVE MAINTENANCE OF OUTPUT—

Operation	Number of observations	Starting time of shift	Period of study	(a) Number of units: (b) Index Numbers[1]	Average output observed each working hour	
					First	Second
Rivet press	64	7.30 a. m.	Oct. 13–30	(a)	630	663
				(b)	91.2	95.9
Roll coil	86	do	do	(a)	246	253
				(b)	96.1	98.8
Magneto taping	63[4]	do	July 23–Sept. 24	(a)	435	471
				(b)	92.4	100.
Commutator loom	15[4]	do	Oct. 23–Nov. 15	(a)	763	871
				(b)	85.2	97.2
Average index numbers					91.2	98.0

[1] Index number=percentage variation from maximum; maximum=100.
[4] Group days.

operation. Thus on the operation of rivet press, the third hour comes out as that of the maximum output and the actual average output per

* Studies in Industrial Physiology: Fatigue in Relation to Working Capacity. Comparison of an Eight-Hour Plant and a Ten-Hour Plant. Report by Josephine Goldmark and Mary D. Hopkins on an Investigation by Philip Sargant Florence and Associates under the general direction of Frederic S. Lee. *Public Health Bulletin* No. 106.

† Table I, pp. 32 and 33.

man per day for this hour (691) is expressed as 100, the average output of all the other hours being then expressed as a percentage of this "standard" productivity.

This standard, as we learn from columns two and four, is based on 86 "observations," *i. e.*, 86 man-days, extending over a period of two weeks, and cannot, therefore, be considered a "snap" judgment. It is a result of conditions existing on twelve different workdays and affecting probably some seven or eight* different persons, and the chances are that everything has canceled out except the fact that the productivity was that of the third hour.

The last column but one, giving the average output for all the hours of the day, may be considered to sum up the comparative loss by low productivity for each operation. The roll coil operation, for instance, shows 96.5 per cent as the average of the hourly productivities over the whole day, which means that the low productivity coefficient $\frac{PP-AP}{PP}$ (possible "Standard" productivity minus actual productivity showing, divided by the possible standard productivity—see preceding page) is for this one operation $\frac{100-96.5}{100}=3.5$ per cent, as measured on the hourly basis in the quantity of output.

EIGHT-HOUR PLANT, DEXTEROUS HANDWORK

Average output observed each working hour									Ratio of spells—second spell to first spell (in per cent)
Third	Fourth	Average for spell	Fifth	Sixth	Seventh	Eighth	Average for spell	Average for day	
691	[1] 654	660	653	642	651	[2] 616	641	650	
100	94.6	95.5	94.5	92.9	94.2	89.1	92.8	94.1	97
256	[1] 252	252	236	252	253	[2] 226	242	247	
100	98.4	98.4	92.2	98.4	98.8	88.3	94.5	96.5	96
451	[2] 448	451	456	455	452	[1] 431	449	450	
95.7	95.1	95.7	96.8	96.6	96.0	91.5	95.3	95.5	99
871	[2] 896	850	856	845	835	[2] 776	828	839	
97.3	100	94.9	95.5	94.3	93.2	86.6	92.4	93.6	97
98.2	97.0	96.1	94.8	95.6	95.6	88.9	93.8	94.9	97

[1] Period of ¾ of an hour; actual output multiplied by 4/3.
[2] Period of 1¼ hours; actual output divided by 5/4.

Hourly Plant Output

We may give in this way the comparative hourly productivity of several squads on various individual operations, but how can we jump from this to a measurement of the hourly productivity of the entire

* The days are 12, the man-days 86. Men=86/12 on the average.

plant corresponding to the inclusive turnover and absence rates that are so freely quoted? The solution bears an obvious resemblance to the measurement of cost of living changes. There is the same difficulty of quoting one uniform figure for a multiplicity of different items—numbers of objects, weights, sizes, etc., and of so weighting the items that the composite whole will present a true picture of what is being measured.

The difficulty of unifying the multiform products is settled just as in the case of cost of living changes, by the index number; the base for this index number (to be represented by 100) lies ready to hand in the hour of maximum output, and the hourly variations in each of the operations studied are expressed as percentage variations from this hour. It will be noticed that this plan bears an analogy to the older method used by the United States Bureau of Labor Statistics in forming index numbers, namely, to express the changes in the price of each commodity by a separate series of index numbers of its own, before combining the commodity prices. The newer method of adding all prices together in their original form before indexing would in our case give undeserved weight to those operations which happen to produce the greatest number of units per hour. Thus in Table I on page 295, if the number of units were added in their original form, the commutator loom operation, where 839 units are produced per group per day on the average, would have over three times the weight of the productivity on the roll coil operation, where only 247 units per man happen to be produced on the average. Yet commutator loom is not necessarily the more important item in the production of the whole plant.

The use of the maximum hour as the basis for index numbers may meet criticism on the score that the maximum is by nature an extreme, and that the procedure is as inconvenient as basing *price* index numbers, say on the inflated prices of 1864, at the end of the Civil War. To this the authors of the *Bulletin* answer as follows:

"It is true that the use of the maximum . . . . is open to certain statistical objections. A [basis of] comparison must obviously not be subject to deviations of an extreme or violent character as a maximum may frequently be. It must offer some guaranty of a fair measure of stability. In the limitations of human working power such a guaranty is afforded in the present case. Spurts may for brief intervals occasion an extreme deviation, but since they do not in any operation last an entire hour, they do not raise any hour so greatly as to invalidate the use of the maximum as a standard.

"That our output figures are not subject to high extremes and are sufficiently massed toward the maximum to permit its use as the standard of comparison is proved by the following figures. The total number of average hourly outputs contained in the tables of both plants and represented in our text by the familiar term "index

numbers" is 344. Grouped according to their variation from the maximum 100, the index numbers are distributed as follows:*

	Index Numbers
From 100 to 96	138
From 95 to 91	112
From 90 to 86	48
From 85 to 81	18
From 80 to 76	12
From 75 to 71	6
From 70 and below	9

"Thus a very high proportion—73 per cent—of these hourly output figures is massed within ten points of maximum; the remaining 27 per cent tapers down to the index number 48. The maximum then affords a satisfactory statistical basis of hourly comparison."

The difficulty now presents itself of so weighting the index numbers that, when added, their total (or average) will form a complete and accurately balanced picture of the whole plant productivity. In measuring cost of living changes, budgets are obtained of family consumption and commodity prices are weighted in accordance with the relative consumption of those commodities. In our case a "budget" must be obtained of the plant operations either through a census of occupations within the plant or, if the factory is small, by personal inspection. These various operations found must then be grouped according to what is considered the most important factor. In the case of a study of fatigue, the important question was held to be whether the operations involved muscle-work or dexterity, or whether it was a machine-operation. Accordingly, in the *Public Health Bulletin* which was mainly concerned with fatigue, the proportion of each type of operation in the whole plant is ascertained. The proportions of the eight-hour plant, which were made the basis for comparison, were as follows: one quarter of the operations, muscular; one quarter, dexterous; one half, machine operations, of which half again were operations on the lathe or "hand-screw" type of machine.

These proportions established, several operations of each of the four types were selected for study and an average derived from them for each type.† Table I, given on pp. 294–5, shows how an average is obtained from the four individual operations studied for the dexterous type at the eight-hour plant. Since each type forms exactly one quarter of all operations in the plant, the unweighted average of the four type-averages gives a representative average for the whole plant.

*For explanation of one additional index number not included here see p. 28 of the *Bulletin*.

†For the machine types an alternative plan is to use the power consumption records which would indicate variations in productivity in a uniform unit for all the different power-driven machinery.

The average "index number" for all the hours of the day on each type of operation in each factory is given below:

TABLE II: AVERAGE OF COMPARATIVE HOURLY PRODUCTIVITIES

Type of Work	Eight-Hour Plant	Ten-Hour Plant
Dexterous	94.9	91.6
Muscular	92.9	86.5
Lathe Machines	92.8	88.9
Miscellaneous Machines	95.3	94.0
Average for Whole Plant	94.0	90.3

As suggested above, these figures show the actual maintenance of productivity throughout the hours of the day and can form the numerator of the productivity ratio (AP). Averaging the four types of operation, the eight-hour plant is seen to have a low productivity coefficient $\left(100-\frac{AP}{PP}\right)$ of $100-\frac{94}{100}=6$ per cent; the ten-hour a low productivity coefficient of $100-\frac{90.3}{100}=9.7$ per cent.

Hourly Plant Accidents

Besides the quantity of output, the *Public Health Bulletin* presents hourly comparisons in great detail for accidents. Just as a direct measure of quality of output would have to present the units spoiled or scrapped as a proportion of the total amount of units of output attempted, so here in the case of the indirect measure, the accidents have to be related to the total amount of production. The investigators were not satisfied with absolute accidents per hour, but give the comparative accidents per given output per hour. The ratio of accidents to output for each hour is arrived at by expressing each hour's accidents and total plant output as a percentage variation from the average hourly accidents and output respectively, and for each hour, dividing the percentage accident variation by the percentage output variation.

The hourly total plant output used as a basis in calculating the hourly accident ratios lies, of course, ready to hand in the composite plant productivity described in the preceding section. Obtaining representative figures for the whole plant presents no difficulties either in the case of accidents. Where accidents are simply used as an indirect measure of the quality of output, the degree of seriousness of the accident is not significant. Few accidents are likely to have been purposely induced by the worker, and the severity of the injury thus controlled. In the majority of cases the seriousness of an accident is not correlated

definitely with the seriousness of the original error on the part of the human being (if any), and thus accidents are of uniform weight where human efficiency and low productivity are under study. The precise basis of the standard efficiency is decided by the purpose in hand. For the purpose of finding the effect of longer or shorter working hours, the basis for the standard minimum risk should be the lowest accident ratio shown on the average by any one particular working hour. This average in its turn should be based on a sufficient number of man-days.

What this standard is can obviously be found only from the factory records—motion or time-study on real accidents is decidedly out of the question.*

Comparative Man-Productivities

It has already been suggested that a second type of comparison, the comparison of man-productivities, would throw light on some further vital industrial issues—the possible existence of accumulated fatigue and nervous exhaustion of individuals, and the possible existence of restricted output.

It is evident that the basis for a solution of these issues is a knowledge of the distribution of working capacities among individuals. In the absence of positive evidence, we must assume that the working capacity of employees in any plant follows the normal curve of error which has been found to hold true of man's physical and mental traits. The distribution will be symmetrical about its mode, which is here equivalent to the arithmetic mean and median, and for any given coefficient of dispersion will assume a definite curvature.

Now the existence of the industrial phenomena we wish to study will be manifest in departures from this normal distribution of man-productivities. The presence of neurasthenics or the chronically fatigued will be ultimately shown in an unduly large frequency in the negative productivity values, possibly even in a second mode on the negative side of the curve, the neurasthenics definitely grouping themselves around a lower level of productivity. The existence of restrictions will be manifest by a departure downwards from the normal level of man-productivity among those of higher capacities, and there will be a sudden check in the progress of the curve at a certain level of productivity (the limit or "stint" generally observed). This non-correspondence with the normal curve of error will result (1) in the curve's being truncated at the higher values on the positive side, *i. e.*, negatively skewed, and (2) in the narrowing of the range of variation be-

* It is, of course, always possible to devise an apparatus which shall reproduce the supposed essentials in accident causation without reproducing its injurious effects. See, for instance, E. S. Bogardus, "The Relation of Fatigue to Industrial Accidents," in the *American Journal of Sociology*, 1911.

tween the more and the less productive, *i. e.*, a fall in the coefficient of dispersion. In the extreme form these results would amount to such a narrow distribution of values that one value would practically be stereotyped, and to avoid the unscientific emotions conjured up by the word "restriction," it is a wise plan to refer to this whole range of phenomena as "stereotyping."

Setting aside the effects of accumulated fatigue on comparative man-productivities for future consideration, we shall concentrate on devising a practical measure for the comparative loss involved by stereotyped production.

This measure to be practical must above all be intelligible and easily used by the ordinary employer of labor as also by the ordinary representative of labor.* We shall in consequence use the system of statistical measurements most easily grasped and most easily calculated, namely the Median-Quartile-Interquartile Range Group. This system of measurement has an additional advantage in that it discounts the extreme values which in the complex situation presented by industry occur so frequently for extraneous reasons.

For instance, in the following table, the lowest average output is some 124 pieces below the next lowest, whereas the interval between all other man-productivities is nowhere greater than 6.3 pieces. It is probable that some special condition is present, personal to this one low-producer without reference to general plant or operation conditions. An average of standard for this whole operation should not be unduly affected by it.

The theoretical disadvantage of the median as an average,† that a correct total cannot be obtained by multiplying the median by the number of items, is of minor importance if we are willing to waive absolute correctness in favor of general tendencies more likely to be correct in the long run. And absolute correctness is not so important where our main object is to measure the comparative efficiency or rather deficiency of different operations, departments or plants, as long as the same method of measuring is adopted in all cases compared. Further, in calculating his labor turnover, it does not matter much to an employer whether his rate is 120 per cent or 150 per cent per year, if his rivals have rates varying from 40 per cent to 80 per cent. In the present state of the science of personnel, we must be content if we can get but one step further in our comparisons than just "bad," "moderate," "fair," "good," "very good."

It was suggested that restriction of productivity will manifest itself

* One of the hoped for functions of a system of labor statistics in the plant is to form a basis for negotiation which both sides will be ready to accept as fact.

† The average is here used as the generic term to cover arithmetic mean, mode, median, etc.

in reducing the more capable individuals to a level of output lower than would "naturally be," *i. e.*, lower than a normal curve of error would admit. Let us make the conservative assumption that the productivity of the least productive half of the men is not affected by restriction. In other words, the average productivity of the lower half, *i. e.*, the lower quartile, remains the same.

We then have to find the average productivity of the most productive half of the men compared with that of the least productive half, *i. e.*, the percentage the upper quartile bears to the lower quartile, (A) under conditions of restriction, (B) under conditions where normal abilities have free play, the difference in the A and B percentages marking the loss in productivity due to restriction.

We can illustrate this method from tables published in the *Public Health Bulletin* (Chapter 4 "Stereotyped or Restricted Output") in which the average output of each man of a large squad is given for two similar operations, one at the ten-hour plant, the other at the eight-hour plant. Unless the operations are really of similar type, it is difficult to eliminate the tendency of the mechanical equipment to restrict output automatically. Thus if in one operation half the time is necessarily consumed by the actual contact of tools and material and this time cannot in any way be reduced by the worker, it follows that the possible increase in speed for the whole operation is physically restricted. Physical restriction will produce exactly the same divergence from the normal expected distribution of man-productivity as would voluntary restriction. Comparison of such a type of operation with, say, a hand operation, would fail to isolate the voluntary restriction.

With this caution in mind let us take the average outputs for the period December 31, 1917–January 17, 1918, of the twenty-one men "forming small end of base on lathe." These figures are given in Table 15 of the *Bulletin*. Arranged in order of magnitude the figures are as follows:

TABLE III: TEN-HOUR PLANT, OUTPUT OF STEREOTYPED OPERATION

FORM SMALL END OF FUSE ON LATHE

Order of Low Productivity	*Check Number of Man*	*Average Output per Day Dec. 31, 1917–Jan. 17, 1918*	*Order of Low Productivity*	*Check Number of Man*	*Average Output per Day Dec. 31, 1917–Jan. 17, 1918*
1st	10484	700.4	12th	10366	836.2
2nd	10420	824.1	13th	10361	836.9
3rd	10493	830.2	14th	10367	836.9
4th	10358	831.0	15th	10560	837.0
5th	10468	832.5	16th	10547	837.3
6th	10353	833.1	17th	10496	837.9
7th	10551	833.4	18th	10440	839.1
8th	10365	833.4	19th	10384	840.4
9th	10355	835.0	20th	10510	846.7
10th	10489	835.3	21st	10508	851.1
11th	10505	835.5			

The value of the lower quartile is the output of a worker coming, to be exact, fifth and three quarters in order.* If we wish to simplify matters as far as possible—an important consideration when appealing to business men—we may take the nearest *actual* worker, namely, the sixth in order. This is what was done in the *Bulletin* we are quoting from. The sixth worker has an average output of 833.1 fuses per day. By similar methods it was found that the value of the upper quartile (the output of the sixteenth worker on our list) was 837.3.

Now the question arises, what would have been the upper quartiles had the output not been stereotyped by any individual worker or, at any rate, not by one half of the individuals. Let us turn to the fullest example given in the *Public Health Bulletin* of a non-stereotyped operation of a similar nature, namely, "axle grinding on lathe," at the eight-hour plant (Table 17). Arranged in order of magnitude, the average daily outputs of the twenty-nine individual workers over the period studied were as shown in Table IV.

The quartile values quoted here are the output of the workers coming nearest to seven and three-quarters and twenty-two and a quarter, *i. e.*, the eighth and the twenty-second. These values are 382 and 408 respectively, the upper quartile being thus 106.806 per cent of the lower quartile.

In a non-stereotyped distribution of man-productivities on a lathe type of operation, then, the upper quartile may be expected to be 6.806 per cent above the lower quartile. Applying this expectation to the forming small end of fuze of lathe, the expected upper quartile

* In calculating the position of the median and quartiles in a series of n items, the author has not used the orthodox formulae (as given for instance by King in his "Elements of Statistical Method," Edition of 1916) to wit: $\frac{n \text{ plus } 1}{2}$, $\frac{n \text{ plus } 1}{4}$ and $\frac{3\ (n \text{ plus } 1)}{4}$. When worked out in spaces along a line, it will be found that these formulae make the interquartile range enclose slightly more than half the total spaces. Thus for 21 item-spaces Q 1 falls at 5½, *i. e.*, exactly between the fifth and sixth spaces. Q 3 falls at 16½, *i. e.*, exactly between the sixteenth and seventeenth spaces, and the interquartile range encloses 11 complete spaces out of the 21 instead of 10½ as it should.

The formulae used by the author, which appear to be spatially correct, are as follows:

Median: $\frac{n}{2}$ plus ½

Lower Quartile: $\frac{n}{4}$ plus ½

Upper Quartile: $\frac{3n}{4}$ plus ½.

In the case of the median, the author's formula gives the same result as the orthodox formula, but the position or rank of the lower quartile is raised by ½ and the position or rank of the upper quartile reduced by ½.

The difficulty has arisen owing to our practice of indicating any space along a line in language by the position of its further boundary point, which, actually, is half the space beyond the center of the space. Thus we speak of a child's being in his fourth year when actually his age is anywhere between three and four and averages three and a half. Hence, to indicate in language any space in an array we must always add half a space to the actual middle of that space.

TABLE IV: EIGHT-HOUR PLANT, OUTPUT OF NON-STEREOTYPED OPERATION

AXLE GRINDING ON LATHE

Order of Low Productivity	*Check Number of Man*	*Average Output per Day (Period Studied was Sept. 19–Oct. 13 and Oct. 29–Nov. 10, 1917)*	*Order of Low Productivity*	*Check Number of Man*	*Average Output per Day (Period Studied was Sept. 19–Oct. 13 and Oct. 29–Nov. 10, 1917)*
1st	4238	307	16th	4452	399
2nd	4287	347	17th	4220	400
3rd	4206	370	18th	4465	401
4th	4282	374	19th	4361	402
5th	4342	377	20th	4289	406
6th	4182	380	21st	4419	407
7th	4003	381	22d	4395	408
8th	4373	382	23d	4318	410
9th	4370	387	24th	4392	411
10th	4354	390	25th	4200	413
11th	4402	391	26th	4221	414
12th	4215	392	27th	4232	416
13th	4276	392	28th	4426	425
14th	4223	394	29th	4350	428
15th	4356	398			

should on that operation be $833.1 \times \frac{106.806}{100.00} = 889.801$. Actually, however we found the upper quartile to be 837.3.

The most productive half of the squad on this "form small end of fuze" operation, therefore, lost. $889.8 - 837.3$ fuzes per day by restriction, *i. e.*, 52.5. Since, however, we assumed the least productive half to lose nothing, the average loss over the whole group is $\frac{52.5}{2} = 26.25$ fuzes per man for the whole squad.

The net average loss in productivity for the whole squad, calculated (according to the formula suggested above) in percentages of the expected upper quartile (the standard probability) is

$$\frac{1}{2}\left\{\frac{\text{Expected upper quartile} - \text{actual upper quartile}}{\text{Expected upper quartile}}\right\} = 2.95 \text{ per cent.}^*$$

ENVOI

In conclusion a word must be said as to the value to sociology of industrial statistics of the type we have outlined. The term sociology is used not as a vague reference to general social righteousness, but in its etymologically correct sense of the scientific *study* of society. It is a common observation that even the calmest students of mankind are likely, when they reach our modern industrial organization, to go wild and to forsake the path of ordinary scientific process for a jungle of vast overshadowing "problems"—the "labor problem," the "trust problem," the "railroad problem." The setting of problems to one's pupils or to oneself is a sure method of progression, provided the problem can be definitely formulated behind a question mark;

*I. e., $\frac{26.25}{889.80}$.

but what exactly is THE question about labor, about trusts, about railroads? A treatise on modern industrial society seems either to confess a wholly perplexed state of mind or else to indicate a reversion to Euclidian geometrics. Probably both elements are present. The sociologist who had been content to describe the manorial economy, the organization of the town gilds, or the arts and crafts of the Senegalese, by piecing together his facts item by item, when he comes to existing conditions abandons the item as a basis and reverses the procedure. He starts from certain general ideas of what is, and when he strikes an item-fact that deviates therefrom, it is a "problem." And general ideas of what *is* are easily polluted by general ideas of what *should be;* hence any and every item that is simply wrong is a "problem," and the erstwhile sociologist is by this time a sort of Big Brother to us all as well as a deductive geometrist.

The only escape from the problem jungle is to go back to the item facts. It is true that modern society presents a plethora of items. Indeed we suspect that some brand of agarophobia was partly responsible for the resort to the "Problem". But it is just against this overwhelming multitude of item-facts that statistics comes to the sociologist's aid. Whenever the items have values that can be measured, the possibility of exact yet inclusive generalization is admitted.

Probably of all forms of modern society the industrial establishment or "plant" presents the greatest chance of collecting measurable items. What is it but its rigid standardization that is most complained of in modern industry? Yet is it not precisely standardization of conditions that social statistics sighs for? Once let the personnel of the industrial plant be regarded not as a tediously refractory part of an automatic mechanism, but as a social organism just as worthy of scientific treatment as the State or the Trade Union; once let the possibilities of a statistical study of its behavior be thoroughly explored, and more light will be shed on the reactions of mankind to its present admittedly difficult predicament than by an infinite solution of problems to their last Q. E. F.

PRICES DURING THE WAR

By Walter W. Stewart, *Amherst College*

In at least one field of economic inquiry the maker of predictions may be held responsible statistically. Since the invention of index numbers, any one who has ventured to forecast the movement of prices has taken the chance that later he may be embarrassed by the facts. Frequently during the war, men tried to predict the course of prices by using the Napoleonic period or the Civil War as analogies; or they showed that government price-fixing was futile as long as credit inflation continued. Now that we may look back on what actually happened, it would seem the very beginning of scientific wisdom to check up, to find out where we went wrong, and to get ready for the next prediction.

All the material necessary for such a checking up is found in the report of the inquiry conducted by the Price Section of the War Industries Board.* In fact, the material is so abundant as to discourage the ordinary reader; he will be impressed by the bulk of the fifty-seven bulletins in which the results are published, conclude that it was an important investigation, and decide to read them later. The results include the measurements of the month to month fluctuations in the prices of fifteen hundred commodities belonging to fifty different industries; an exhaustive study of government control over prices; and a comparison of the price movements in the United States with those in thirteen other countries. An inquiry so comprehensive cannot readily be summarized within the limits of a review. The best that can be done is to describe the plan of the inquiry, to indicate some of the ways in which it differs from other investigations into price movements, and to comment briefly on certain of the results.

The feature of the plan which made necessary the collection of so large a number of price quotations was the desire to secure satisfactory samples of prices of both materials and products for each of the fifty industries included in the survey. Merely for the purpose of measuring the change in the general level of prices, a smaller number of commodities might have been sufficient. But if, for example, one wishes to compare the cost of materials in a certain industry with the prices of the products, or to measure the diversity of price change during a general rise, or to explain the fluctuations of controlled and uncon-

* History of Prices During the War. Summary. Wesley C. Mitchell. *War Industries Board Price Bulletins*, No. 1. Washington, Government Printing Office, 1919.

trolled prices, then a longer list of commodities is necessary. In this latter range of problems the present inquiry makes its chief contributions. It is mainly a "statistical study of the internal structure of the system of prices," an attempt to "show how the various groups within the total system of prices have behaved."

"Prices constitute a system in the literal sense that they are so connected as to make a complex whole. To understand the workings of this system at any given time and the change it undergoes from one time to another, it is necessary to trace the interconnections among the various parts of the system. These interconnections are numerous and varied in character. The whole system of prices is not a miscellaneous aggregate of simple commodities, but an organized combination of groups of commodities. The prices of articles within these groups have especially intimate relations with each other and the groups themselves cross each other in rather perplexing ways" (p. 92 of the *Bulletin*). An understanding of the behavior of these various groups is necessary also in order to determine the extent to which a general movement of prices is controlled from within.

The simplest explanations of price movements ordinarily use an oversimplified concept of the price-level. To regard a single series of averages of prices of commodities at wholesale as an index of the "price-level" has the convenience and the dangers of any other oversimplification. Its merit and its defect is that it reduces into a single figure the highly diverse fluctuations of prices, with the advantage that it makes possible the discussion of a general trend of prices and with the disadvantage that the monetary theorist seldom discusses anything else. Only occasionally does he recognize that this apparently simple "price-level" average is in fact the net result of diverse movements within the system of prices. And on those occasions he usually saves himself the necessity of measuring the actual diversity by means of an unverified hypothesis; he assumes, other things remaining equal, that whenever prices in one part of the system rise there must be in some other part of the system a compensating fall.

The study of price movements, however, is wider than the field of monetary theory. It may be convenient to regard the general purchasing power of the dollar as (mathematically) the reciprocal of the price-level, but it does not follow that all the general changes in the level of prices can be attributed (causally) to monetary phenomena. Therefore, without denying the existence or significance of the general movement as measured by the index of the price-level, the statistician also employs various devices which reveal the complexity of the changes taking place within the system.

One measure of the dispersion of prices furnished by this study consists simply in arranging the price quotations on a scale which shows the magnitude of their relatives for each year (p. 12). The purpose of this arrangement is to indicate the diversity of the fluctuations, entirely apart from any question of the character of the commodities. It shows "(1) that the total array of commodities is characterized by a high degree of concentration, (2) that the degree of concentration declines each year, and (3) that the point where most commodities are found moves higher in the scale of relative prices as the war goes on" (p. 21). The tendency of prices to scatter as they rise and to swarm again as they fall has been observed in other studies of price movements made by Professor Mitchell. Apparently there was greater dispersion of prices from1913 to 1918 than during the Greenback period; prices, on the average, did not rise so high, but they scattered over a wider range. In 1865, when Civil War prices reached their peak, they were more closely massed around the point of densest concentration than were prices in 1918. It is not surprising that the dispersive influence upon prices of a World War which upset many international markets was greater than that of a war in which only the area of the Confederacy was isolated, and the Union States kept their contacts with the rest of the world. Further comparisons should be made between the degree of dispersion during these periods of rapid rise in prices and the more ordinary fluctuations of prices incidental to the business cycle. Such a study might not result in a formula of "normal dispersion," but it should yield some useful observations.

Another device is used to indicate the commodities which fell in price and those that rose the most. It consists of a list for each year of the fifty commodities showing the lowest relative prices and the fifty showing the highest. No very broad conclusions can be drawn from this because the list includes each year only 7 per cent of the entire list of 1,437 commodities. It does show, however, that a considerable number of chemicals kept high in the list throughout the war; that certain important commodities imported from neutral countries, such as rubber and coffee, are among the fifty "lowest"; and that some of the military essentials whose production needed to be stimulated rose to several times their pre-war prices.

This method of listing the highest and lowest touches incidentally on the matter of the price changes in imports and exports. "Imported goods are disproportionately numerous, not only among the articles that rose violently in price but also among those that declined" (p. 16). The reason that many of the important exported articles do not appear also on the list of the "highest" is chiefly because of the brevity

of the list. For it is probable, from what we know of the foreign trade situation, that weighted indexes of the prices of imported and exported articles would show that during the war import prices rose less than the general level, while export prices rose higher than the general level.* Two forces were at work keeping down the prices of imports: first, the imports from Europe, which was the center of disaffection for price revolutions, fell off markedly; and, second, imports of important materials from South America and Asia, which were shut off from some of their former European markets, declined in price and constituted a greatly increased percentage of total imports. Exports, on the other hand, were made up of articles which rose rapidly in price. The expansion of exports before the United States entered the war consisted largely of war goods, whose prices had been bid up by the Allied governments. The extent of this rise is indicated, for example, by the way the index number for the metals group, which includes many exported war materials, ranged above the index for "All Commodties" throughout the period of large exports. For a history of prices during the war there is no topic more important than a study of the influence transmitted to us by our trade with the rest of the world.

The interest in this problem gives point to the comparison made of war prices in various countries. For the purpose of these comparisons special index numbers were constructed measuring the change in identical lists of commodities in each of the two countries compared. The price rise in the United States started later than it did in England or France, rose more slowly, and during the whole period kept to lower levels. An analysis of the causes for these differences will require a great deal of detailed information which can be interpreted only by one familiar with conditions in the countries compared. Even in times of peace, when price fluctuations in different countries tend to correspond, international comparisons are not simple. When the countries are at war and the governments are regulating imports and exports, subsidizing certain industries, and in various ways controlling prices, the complexity is baffling. This study makes a beginning in the analysis and furnishes a considerable part of the material needed for further investigation.

That government price control checked the rise in the general level

* This probability appears to be borne out by the index numbers for imported and exported commodities constructed by the Division of Analysis and Research of the Federal Reserve Board. So far, these index numbers have been constructed only for the years 1913 and 1919, but their position in those years gives some indication of how the prices moved during the war. When completed these new series will be especially valuable in a study of international trade, since they provide import and export price-indexes not only for the United States but also for several foreign countries. See *Federal Reserve Bulletin*, May, 1920. Pp. 499–503.

of prices will not be questioned by those who believe that the control over the prices of basic materials was not necessarily neutralized by a bulge in prices elsewhere. The facts are that the commodities over which the government exercised price control were for the most part the very commodities upon which fell the burden of war demand; that as a group these prices were higher than other prices before the United States entered the war; and that they were very much more affected by the declaration of war than were the others. No doubt, the fact that the prices of the commodities ultimately brought under price control were already high "facilitated the effort to prevent a further advance or even to reduce prices" (p. 43). Yet, without price-fixing, there is no reason why these prices should not have continued to advance and along with them the general level of prices. The truth is, that a year after the first effects of price-fixing were felt—after twelve months of war and of financing by inflation—the price level stood exactly where it was when price-fixing began. Price control, working under the handicap of inflation, accomplished results which somehow must be given recognition by any theory which attempts to account for the price movements of the period.

A summary of the foregoing in the form of a condensed narrative may indicate some of the causal connections. Prices in the United States began rising the middle of 1915, under the influence of large orders for war materials placed by England and France. This demand for export communicated to the United States the rise which had begun earlier over there. When the United States entered the war, prices were 60 per cent above their pre-war level; during the next four months they advanced 20 per cent. From that time until the armistice —sixteen months—the chief factor was price-fixing; the level of prices fluctuated within a comparatively narrow range and at the end was only 6 per cent above the point it had reached when price-fixing began. The causal connection lies partly in the fact that the goods first exported on a large scale were the same commodities that later became essential for winning the war, many of which were ultimately brought under price control. They were of sufficient commercial importance to exercise a dominating influence upon the price-level. Their rise before the entry of the United States into the war, their subsequent abrupt increase, and then their relative stability under regulation, pointed out the direction which the general level of prices tended to follow.

The question of how the Price Section measured these changes in the general level of prices—the method of constructing the "All Com-

modities" index number, remains to be considered. Without going into all the technical details it is desirable to compare this index with the index number compiled by the Bureau of Labor Statistics, for one of the points of interest is the close agreement in the results reached by the two. The question arises whether this agreement furnishes a mutual verification of results independently arrived at, or whether it rests upon similarities of construction.

In the opinion of Professor Mitchell, "the close harmony between the latter [the series compiled by the Price Section and by the Bureau of Labor Statistics] does not arise from similarity of construction. Indeed, the new series includes over four times as many commodities as the old and has a different system of weighting. That independent investigators, utilizing different data, and applying different methods should reach such similar results in a period of such extraordinary changes is one more welcome indication that it is possible to measure the fluctuations of the wholesale price level with substantial accuracy, and also that the more careful the measurements taken the better will they agree" (p. 29).

There are some important respects in which the two index numbers are similarly constructed. Both belong to the same general form of index number—relatives computed from weighted aggregates of actual prices. The method of weighting the separate commodities is not greatly different. The bureau uses the estimated amount of the commodity "entering into trade" in a given year, an estimate which has to be based largely on the figures for production; the Price Section uses production plus imports in the year 1917, apparently because it is the nearest equivalent to the amount "entering into trade" (p. 22).

In addition to these commodity weights, however, the Price Section uses a second set called "class weights." The use of these class weights and the larger number of commodities included in the Price Section Index constitute the main differences in construction. It is important, therefore, to inquire into the influence of these two factors.

The class weights were used in order that the influence exercised by each class upon the "All Commodities" index would be in proportion to their relative importance in the system of prices. That is, in case the weights for the separate commodities threw the scheme of weights out of proportion for purposes of measuring the general trend, the class weights would serve as a corrective. The influence upon the "All Commodities" index of each of the various groups after the class weights were applied is presented in the following table. There is also

presented the influence of the corresponding groups on the Bureau's index number.*

Groups	Price Section Per cent of Influence	Groups	Bureau of Labor Statistics Per cent of Influence
Food	45.5	Farm products and food	52.9
Clothing	13.7	Clothing	11.6
Metals	18.2	Metals	9.8
Fuels	7.6	Fuel and lighting	10.2
Building materials	4.2	Lumber and building materials	7.7
Chemicals	5.6	Drugs and chemicals	1.5
Rubber, paper, fibers	5.2	Miscellaneous	5.9

The agreement in the proportionate influence assigned the various groups by the two methods of weighting is closer than appears on the face of the figures. Some of the differences in percentages are due to differences in classification of certain commodities and not to differences of weighting. Cotton and hides, for example, are placed by the Bureau in the Farm Products group, and by the Price Section in the Clothing group. If these commodities were transferred to correspond to the classification of the Price Section, the agreement of weighting between groups would be closer. Except in the case of the Metals group, the influence exercised by the various groups upon the two different "All Commodities" indexes is quite similar. In both, the aim is to assign to each group a weight which corresponds to the commercial importance of the commodities in the trade of the country —by slightly different methods they arrive at similar results. In fact, it is probable that the class weights bring closer agreement between the two series of index numbers than would exist in their absence.

There are also reasons why the 1,437 "commodities" carried by the Price Section as against the 309 carried by the Bureau (in the year 1917) result in only small divergences between the two series. In the first place, all the commodities quoted by the Bureau are also carried by the Price Section. These include all the leading raw materials which, because of their commercial importance, are assigned a very large percentage of the weighting in both series. Also, many

* The percentages given for the Bureau of Labor are for the year 1917, because that year is used by the Price Section as a base year for weighting. In the comparison, the following adjustments are made: (1) The Bureau's groups of Farm Products and of Food are combined and compared to the Price Section's group of Food; (2) the group of Miscellaneous is compared to the group of Rubber, Paper and Fibers because they contain many of the same commodities—rubber, paper, wood-pulp, jute and rope are in both and carry the larger part of the weighting—(3) the Bureau's group of House-furnishings is omitted altogether, because there is no corresponding group in the Price Section index; in the Bureau's scheme of weights it counts for only four-tenths of 1 per cent.

of the additional commodities are in classes which are commercially of less importance. The Price Section quotes, for example, 281 chemicals, 20 per cent of the total commodities carried, while the Bureau quotes only 18; but the influence of the chemicals in either case on the "All Commodities" index is limited by the small percentage of weight assigned it by the scheme of weighting. Furthermore, the larger number of commodities is partly explained by the fact that in many instances the Price Section carried a large number of price series for almost the same commercial product. In hides and skins, for example, the Price Section has 48 quotations and the Bureau only 3; in leather, the Price Section has 51 and the Bureau 4. Bituminous coal, for which the Bureau carries 3 quotations, counts in the Price Section as "15 distinct commodities each of which is represented by its own series of prices" (p. 4). This full representation of different grades and markets is indispensable for a complete study of prices in the industry concerned, which was the main purpose of the Price Section; but their inclusion as additional commodities could hardly be expected to exercise any considerable influence on the index for "All Commodities."

The conclusion, then, to be drawn from this comparison is that the Price Section index number is constructed along lines sufficiently similar to those of the Bureau of Labor Statistics, so that their agreement in results cannot be regarded as furnishing independent verification. It is perhaps unnecessary to add that the two series are the best index numbers yet constructed, and that independent verification is not necessary in order that one may have confidence in them both.

Both series, however, still leave something to be desired. In fact, the agreement between the two is partly due to a shortcoming common to them both. Both series probably overstate the degree of fluctuation in the general level of prices. This is due to their under-valuation of the importance of manufactured goods in the system of prices. This difficulty cannot be avoided at present by gathering additional quotations, because the information concerning the prices of these goods is not available. But one of the functions of a system of weights is to overcome if possible such unavoidable shortages in quotations.

The class weights used by the Price Section do not accomplish this because the weight is applied to the price aggregates for the whole class, without distinguishing between the raw materials and manufactured goods. In establishing the class weights, allowances were made for "the value added by manufacture," thus tending to increase the relative importance of those classes composed largely of manufactured commodities. But the class weights did not increase the importance of manufactured goods *within* the class, or give to the prices

of those goods any separate or special influence on the index for "All Commodities."

Special index numbers for manufactured goods were constructed for a number of different industries and published in the class bulletins. They show that the prices of manufactured goods fluctuated within a narrower range than the prices of raw materials. It is probable, therefore, that if a scheme of weights were used that gave to manufactured goods the importance they deserve, that the index number would show a less marked increase. We cannot now measure the precise degree of this exaggeration, but it is desirable to make allowance for the fact when discussing problems of general price change. The inclusion of a large number of heavily weighted raw materials may have the advantage of making index numbers more sensitive barometers. It also has the disadvantage of overstating the actual range of fluctuation.

Improvements in the methods for measuring the general change in prices is only one, and perhaps not the most important, of the still unsolved statistical problems concerning price fluctuations. Professor Mitchell in closing his Summary gives a list of topics requiring further investigation. The inquiry by the Price Section has succeeded in making "two problems grow where one grew before," and it has furnished the statistical material necessary for working on both problems. Any one interested in the study of price movements should see to it that he has the whole set of 57 bulletins. They will stand as the fullest collection of information about prices for a period which is unequalled in the complexity of the causes influencing price fluctuations.

CONTROL STATISTICS OF COAL PRODUCTION AND DISTRIBUTION

By F. G. Tryon, *United States Geological Survey*

The high prices of coal which have prevailed in the United States since the withdrawal of the government maximum prices on April 1, 1920, and the apprehension of a fuel shortage voiced both in this country and in Canada, have lent new importance to statistics of coal production and distribution. This article is an attempt to discuss what may be called the "control" statistics of the soft-coal supply. For many facts about the coal industry, such as labor, wages, mining methods, reserves, costs, investment, and profit, annual measurements are frequent enough, and the discussion of these subjects will not be attempted here. But the facts of production and distribution change so swiftly that monthly or even weekly and daily measurements of their broader aspects are necessary for intelligent planning either by the industry or by the government. To prevent misconception, be it said at the outset that "*control statistics*" is here used as a technical term and has no reference to government regulation. It connotes not statistics to control the industry, but rather operating records by which the agencies interested in coal production and distribution—operators, miners, railroads, dealers, and consumers—may guide their work. The need for operating statistics of the coal industry is always with us, but at a time like the present it becomes imperative. Decisions of policy, such as the laying of an export embargo, and the execution of specific plans formulated to carry out the policy, require accurate records, promptly available, of how coal is moving from mine to market. There is every prospect, moreover, that the need for such operating records will be acute for months to come. Overcoming the transportation disability which has been the limiting factor in coal production since the coal strike of 1919, and rebuilding consumers' stocks of coal will take months. The complicating factor of the demand for export overseas, which though not the prime cause of the present high prices has yet had a disturbing effect on the distribution of the coal produced, is likely to continue for years. As long as it does, even superabundance of coal in the interior will not solve a recurring problem of distribution at tidewater points—a problem which will require accurate statistics available at frequent intervals.

For the sake of brevity, bituminous coal only will be considered in this paper. This is not because anthracite plays an unimportant part

in the economy of the country, but rather because the anthracite industry has at length achieved a condition of stability. Anthracite, though exported in large amounts to Canada, is not shipped overseas in significant quantities, and its market in the United States is confined to 23 states in the North and East. The reserves underground are limited, the production is relatively constant, and its distribution and consumption present few new problems. The mining of anthracite yields a major product, the domestic sizes, and a by-product, the fines or steam sizes. The one cannot be produced without the other, and the problem of anthracite distribution may be summed up in the statement that there is a chronic shortage of the domestic sizes and a chronic over-supply of the steam sizes.

In sharp contrast to anthracite, bituminous coal is mined in thirty states and produced in bewildering variety. Each field has its own market, determined by the quality of its coal and by the freight rate, and the competition between fields is keen. Bituminous mining is normally beset by an uncertain demand. Most fields are affected by a seasonal fluctuation in demand, and all respond quickly to changes in the general tone of business. When the market is active, a shortage of transportation usually develops, and as a mine runs only when cars are available, its output varies greatly from day to day. These factors make the distribution of bituminous coal a complex and ever-changing variable which must be measured at frequent intervals.

Production

The subject of production is treated in the weekly coal report of the *United States Geological Survey*, begun by C. E. Lesher in July, 1917. Weekly estimates of the total production of anthracite and bituminous coal and beehive coke are published, based in each case upon statements of the number of cars loaded by the railroads, collected either direct from the roads themselves or through the American Railroad Association. As the great bulk of the coal not converted into beehive coke at the mines is loaded into railroad cars for shipment, these figures furnish a solid basis upon which to estimate the total mine output. A formula is used which seeks to take into account the tonnage shipped by water, burned at the mines for steam and heat, sold to local trade, used at associated manufacturing plants without transport, or carried by certain small roads not reporting.

The estimates are published in a preliminary way within one week of the period represented. They are usually revised at least twice, as more complete data become available, and then stand as the accepted figures of production until the results of the annual mine canvass are

known, at which time it is possible to check the results obtained by the formula against the total mine production ascertained by actual count. Experience indicates that the margin of error in the figures of weekly production probably does not exceed 2 per cent. In 1918, for example, the sum of Mr. Lesher's weekly estimates, published January 4, 1919, was 585,883,000 net tons of bituminous, and 99,473,000 net tons of anthracite. The mine canvass completed six months later gave a final figure of 579,386,000 tons of bituminous, and 98,826,000 tons of anthracite. The error in the estimate was thus for bituminous, 6,497,000 tons, or 1.1 per cent; that for anthracite, was 647,000 tons, or 0.7 per cent.

The statistics of total weekly production may be regarded as adequate. We need also, however, at least monthly statistics of production by states and by fields. It is not enough to know the total output, for a shortage in one locality may exist simultaneously with a surplus in another, and yet because of transportation difficulties the surplus may be unavailable to meet the shortage. Furthermore, there is as great a variety of coals as of cloth, and it frequently happens that coals suitable for a special purpose may be in short supply when an abundance of fuel for other purposes exists. A feature of the coal market in the Northeast throughout the present year has been a scarcity of coals suitable for gas manufacture, and at seaboard a scarcity of the low volatile coal. It follows that current statistics of output, by fields, will at the same time yield a measure of the output by grades of coal. In an attempt to meet the need for current production statistics, by localities, the *Geological Survey* has begun the publication of monthly estimates of production, by states based upon railroad shipments. Certain technical difficulties in separating between one state and another the tonnage of coal originated on railroads loading in more than one state must be overcome, however, before the estimates can be brought to the accuracy desired.

For ordinary purposes weekly statistics of production are sufficiently frequent. At times, however, daily statistics become necessary, as was the case during the bituminous coal strike of November and December, 1919. Happily, the raw material upon which to base such estimates is at hand in daily telegraphic reports of coal loaded by the principal carriers which are received by the American Railroad Association. From these it is possible to approximate the tonnage of coal produced on a given day within 66 hours of the close of work on that day.

Factors Limiting Production

Of scarcely less importance in intelligent direction of the industry are current statistics of operating conditions at the mines which will isolate the factor limiting production in each district, and thereby make possible the application of remedial measures. Pioneer work in this direction has been done by Mr. Lesher of the *Geological Survey* in the system of weekly mine reports established during the war and maintained since. The arrangement is purely a voluntary one which has, however, received generous support from producers of coal. Each mine is asked to report at the end of the week the number of hours it has worked, and the number of hours it was shut down, the latter distributed among various possible causes of loss, rail transportation disability, shortage of labor, strikes, mechanical breakdowns in the mine, lack of orders, or other causes. The mine reports are assembled with the assistance of local operators' associations and forwarded to the *Geological Survey* at Washington. In districts where no association has been organized, the mines report direct to Washington. The work of tabulation and analysis is the only part of the task performed personally by the staff of the *Survey*.

The time worked and lost at each mine is weighted by its hourly production and the results are averaged and expressed in percentage form, district by district. Because of the large number of individual statements to be assembled and tabulated, it has been found impracticable to publish the returns before two weeks after the period they represent.

The weekly operating reports have established their usefulness as an indicator of the particular factor to which attention must be directed if production is to be brought to a maximum. They are essentially control statistics, possessing incidental value as permanent records, but chiefly useful as a barometer of change from week to week. It is unsafe, for example, to cumulate the losses attributable to a particular factor from one week to the next. Elimination of one factor limiting production may bring into play others whose influence has hitherto been obscured by the first.

Useful as are the weekly operating reports, there are many points in which the present system of obtaining them is subject to criticism. Since the Fuel Administration went out of existence, it has been possible to secure reports from only about 3,000 out of the 7,000 commercial mines, or from approximately 60 per cent of the total tonnage. The returns actually received are believed to be so distributed as to be fairly representative. More complete returns are,

however, greatly to be desired, especially as the statements based on these figures are widely accepted as a measure of the service rendered by the railroads in supplying cars for the operation of the mines, a subject of frequent controversy between the producers and the carriers of coal. A still more important criticism of the present system is that it provides no way of checking the accuracy of the statements submitted by individual operators. The temptation to exaggerate the extent of a car shortage is strong, and in the interest of accuracy some arrangement is desirable for periodical inspection of the reports in the field, and for a systematic checking of the statements of the operators against the records of the railroads themselves.

Distribution

A current record taken at monthly and in some cases even weekly intervals of the movement of coal from mine to consumer, is important even in normal times as a guide to both the shipper and the purchaser of coal. Comparisons of the present movement with records in preceding years will show whether coal is being shipped into a particular locality in normal volume or not, a fact which is of value to the purchaser in laying plans for buying coal, and to the shipper as a guide to his selling campaign. When the market becomes disturbed and methods of controlling distribution are being discussed, a record of this movement becomes an imperative public need.

The importance of distribution statistics can be made clear by an illustration: A cause of much concern in the present coal year has been a sharp decrease in the movement from the Northern Appalachian region to Lake Erie ports, for transshipment to the head of the Lakes. Now the Northwestern states draw their supply in part from the Lake docks, and in part from the mines of the Middle West, particularly Illinois. To know whether there will be a shortage of coal in the Northwest next winter, it is not sufficient to watch the Lake shipments alone. A current record must also be kept of the quantity of coal shipped north, past Chicago, from Indiana and Illinois. For to the extent to which the latter fields are increasing their shipments to the Northwest, a decrease in the Lake tonnage may be viewed with equanimity. The illustration is a simple one, and is only one of many that might be cited. Regardless of whether the readjustment of distribution be accomplished by the trade itself or by quasi-public control, a record of the principal facts from week to week is a necessity.

Two methods of recording distribution present themselves, both dependent upon the records of the railroads. The first and most complete is to assemble copies of the waybills for every car of coal

shipped, and to tabulate and analyze them in some central office having jurisdiction over all the roads in a given locality. Excellent work of this character is now being carried on by the Ohio Bureau of Coal Statistics, a railroad organization with headquarters at Columbus. Although the results obtained from working up the waybills of coal loaded are accurate in a high degree and susceptible of presentation in great detail, a month or two must elapse before the figures become available. The advantage of the second method of measuring distribution lies in the promptness with which results can be made public. It consists in holding up the stream of coal on wheels at critical gateways and junction points, establishing, as it were, gaging stations for the measurement of the rate of flow. An example of such gaging records are the figures of cars dumped daily over tidewater piers at the North Atlantic ports. Like the first method, this depends upon the coöperation of the railroads or of the coal exchanges where such organizations exist.

A third method of collecting distribution statistics, which may be used where no records are kept by the railroads, is to assemble statements from the operators themselves through their local associations. To make the record really valuable, however, it must be complete, and completeness is difficult of attainment for an operators' organization, membership in which is never compulsory.

The part of the government in preparing statistics of distribution should, it is submitted, be confined to coördinating the work of private agencies and supplementing it where necessary. At present distribution statistics are available covering the following major movements:

(1) Rail movement through Hudson River gateways to New England—weekly
(2) Cars dumped over tidewater piers—daily and weekly
(3) Disposition between coastwise, bunker, and export of coal handled at Charleston and Hampton Roads piers—weekly
(4) Same for all Atlantic ports—monthly
(5) Exports from Atlantic ports, by country of destination (lately established by the Department of Commerce)—weekly
(6) Cargo and bunker fuel dumped at Lake Erie ports—daily and weekly
(7) Destination of same—monthly
(8) Coal passing through Sault Ste. Marie canals—monthly
(9) Coal received at head of Lake Superior—monthly
(10) Exports to Canada—monthly
(11) Detailed distribution statistics for coal mined in Ohio—monthly
(12) Details of westbound movement from the "Crescent," Western Pennsylvania, West Virginia, and Eastern Kentucky—monthly
(13) Distribution records, more or less complete, kept by operators' associations in Indiana, Illinois, and the Rocky Mountain States—weekly or monthly.

This system of distribution records requires extension and supplementing as follows:

(1) More complete figures on rail movement to New England—weekly
(2) Complete weekly figures as to disposition of coal dumped at tidewater
(3) Shipments by car ferry to Canada—weekly
(4) All-rail exports to Canada—weekly
(5) Shipments westbound from the docks at the head of Lake Superior and Lake Michigan, by destinations—weekly
(6) Complete detailed statistics of distribution from Indiana and Illinois and Western Kentucky—monthly
(7) Same for Northern and Middle Appalachian region not now covered—monthly
(8) Same for Southern Appalachian, including Alabama—monthly

With these statistics at hand, a comprehensive picture of the distribution of bituminous coal in the territory east of the Mississippi and Missouri—the part of the country where a distribution problem can be said at present to exist—would be possible. As pointed out above, the work can be done most successfully by the railroads and the operators' associations, the government confining its activities to coördinating the reports of other agencies and occasionally to collecting the details where no local agency exists. The Fuel Administration's records of distribution during the war period furnish a background against which to measure present performance in the distribution of coal. That the government must itself undertake the final collection and analysis of the results is clearly indicated by the jealousies between shippers and carriers which militate against the free exchange of information between them. The total cost to the government of obtaining these distribution figures would probably not exceed $10,000 a year, if the work were carried on in conjunction with other studies of coal production and distribution.

Stocks

The subject of consumers' stocks of fuel is almost a virgin field. Prior to the war it had remained entirely unexplored. Yet when a sufficient store of data concerning stocks is available for comparison, stocks are likely to prove the most significant single barometer of the coal supply, for stocks constitute the consumer's reserve against an interruption to his line of communication.

In the United States it is not customary to store coal above ground at the mine, nor is there any present indication that the practice will be adopted in the future. It has been aptly remarked that the cheapest place to store coal is underground in the coal bed. Every rehandling of coal adds greatly to the cost laid down at the consumer's door.

Furthermore, since the limiting factor in times of fuel shortage is almost always transportation, accumulations of mined coal at the mine mouth would avail but little. What is wanted is coal at the factory, not coal at the mine.

The quantity of fuel which is available for use at any one time thus consists of the coal en route and of the coal already in the hands of the consumer. The first is a sort of mobile reserve; it comprises the coal on wheels and the coal held on the commercial docks at the head of the Great Lakes and at New England tidewater points. The coal on wheels is a more or less constant quantity, like the raw material in process at a manufacturing plant. While the docks at the head of the Lakes constitute the greatest coal-storage plant in the world, with a capacity of 15,000,000 tons of bituminous coal, the quantity on hand at the docks varies greatly from summer to winter and should, therefore, be excluded from figures of consumers' stocks, if it is desired to make them comparable. For this reason the dock coal is regarded as a part of the coal in transit rather than part of the commercial stocks.

At many establishments it is the practice to carry small stocks and to depend chiefly on the mobile reserve of coal in transit. It is this type of plant that is the first to suffer in a sudden tie-up of transportation, such as may be caused by a great storm or by a railroad strike. Storms like those of the winter of 1917–1918 are hurtful because they make unavailable the mobile reserve. The suffering at such a time is due not so much to a stoppage of production at the mine as to an interference in the delivery of coal already loaded.

Stocks, therefore, are a very useful barometer of the coal supply. They are the final proof of whether or not production has been keeping pace with consumption. Other things being equal, very large stocks are a sign that the market has been oversupplied and forecast a season of low prices. Depleted stocks, on the other hand, show that production has fallen behind consumption and forecast a period of active demand and consequently of high prices. Data on stocks would, therefore, furnish a fact basis for the ordinary commercial transactions of buying and selling coal. Moreover, in formulating a program of distribution, a knowledge of consumers' stocks is indispensable. When in June, 1920, representatives of New England and of the Northwest appeared before the Interstate Commerce Commission, praying for priority in the distribution of the limited quantity of coal then being produced, the most significant test of the solidity of their claims was the general level of stocks in the two localities.

The task of taking a complete count of stocks is very great. The number of commercial consumers was found by the Fuel Administra-

tion to exceed 90,000. Only a large statistical office, devoting its primary attention to the maintenance of a mailing list of commercial consumers of coal, could hope to obtain a complete count of stocks and even then completeness would be purchased at the sacrifice of rapid publication of results. The very magnitude of the task suggests that better results could be obtained by sampling. An experiment in this direction, begun by the Fuel Administration in the first quarter of 1919 and repeated by the Bituminous Coal Commission in coöperation with the *Geological Survey* in June, 1920, indicates that by addressing a limited list of perhaps 5,000 representative consumers well scattered over the country, and ascertaining both stocks on hand and current consumption, it is possible to express the stocks in terms of weeks' supply, a common denominator for all localities, periods, and types of consumers.

Having obtained the average week's supply at the current rate of consumption, for the major groups of consumers, we may approximate the total quantity of coal in commercial storage by weighting the stocks of each group by their weekly requirements. Calculations of this sort are necessarily estimates and are subject to a considerable margin of error, but it is possible to check the results against the known production and the apparent consumption, taking into account exports and imports. Subjected to this test, estimates of total commercial stocks which were wide of the mark would involve sudden and erratic changes in rates of consumption which did not square with other facts of record. The following estimates of total commercial stocks from October 1, 1916, to June 1, 1920, built up from sample reports of weeks' supply, meet this test fairly well.

TOTAL COMMERCIAL STOCKS OF BITUMINOUS COAL IN THE UNITED STATES
OCTOBER 1, 1916, TO JUNE 1, 1920

	(Net Tons)				
October 1, 1916	from	25 to 29	million	probably	27,000,000
October 1, 1917	"	26 to 30	"	"	28,100,000
July 15, 1918	"	38 to 42	"	"	39,700,000
October 1, 1918	"	58 to 60	"	"	59,000,000
Day of the Armistice	"	62 to 64	"	"	63,000,000
January 1, 1919	"	57 to 59	"	"	57,900,000
April 1, 1919	"	38 to 42	"	"	40,400,000
March 1, 1920	"	22 to 26	"	"	[a]24,000,000
June 1, 1920	"	18 to 22	"	"	[a]20,000,000

[a] Subject to revision.

These figures, it may be remarked in passing, indicate the necessity of putting into storage some 10,000,000 tons of coal between June 1, 1920, and the following winter, a fact of great importance in fixing the amount of coal to be produced weekly and for which railroad transportation must be provided.

The collection of data on stocks is clearly a task for the government. Although the details of distribution can properly be recorded by the

shippers and carriers of coal, consumers display a pardonable reluctance in divulging their stocks and requirements. It is believed that the time is ripe for a quarterly canvass of stocks in the hands of representative consumers. The results should be made available in preliminary fashion within a month after the date of stock-taking. The total cost of such a quarterly stock report would not exceed $10,000 per year.

Requirements

In obtaining statistics of stocks, the most uncertain element in future requirements will be cleared up also. We are accustomed to speak of the extraordinary increase in fuel consumption during the war period, and of the slump in consumption during the year 1919. The figures of production for the two years, 1918 and 1919, are indeed startlingly wide apart—579,000,000 tons in the war year, and 458,000,000 tons in the year of reconstruction. But of the difference—121,000,000 tons—probably not more than 51,000,000 tons represented a variation in the rate of consumption, the larger part—70,000,000 tons—being changes in stocks. For during 1918 there was a net addition to stocks of 30,000,000 tons, and during 1919 a net draft on stocks of 40,000,000 tons. In other words, any one attempting to forecast requirements at the beginning of 1919 would have been more concerned with the stocks then on hand than with the depression in business activity, great as the latter was to prove.

The consumption of coal is a fairly constant quantity, except as affected by the seasons and by business depressions. We are constantly adding to our store of information concerning the normal seasonal fluctuation in consumption, but we cannot yet predict whether the winter will be cold or mild. The forecasting of business depressions is beyond the ken of the coal producer. However, given information as to stocks, a certain season of the year, and a healthy tone of business, the monthly consumption of fuel may be predicted with a considerable degree of success.

The experience of the Fuel Administration indicates that the best way to build up a budget of requirements is to make use of records of past consumption, with allowances for changes to be expected, rather than to ask each consumer of coal how much he is likely to need. The latter is not only burdensome and time-consuming, but in practice is likely to yield very unreliable results. The job is so big that no one ever tries it unless a shortage of fuel is believed to be impending; at such a time every consumer will overstate his requirements in the belief that the record will be used as a basis for allotting the limited supply of fuel, and the resultant inflation may be great. The subject

of requirements is important enough to warrant the most careful study. It is a subject, however, where hindsight is as necessary as foresight, and progress is likely to be made in proportion as our information as to actual consumption of coal, by industries, by localities, and by seasons, becomes more detailed and exact.

Prices

The importance of current records of prices is so obvious as to require no comment here. They are watched intently not only by buyers and sellers of coal, but as a measure of the social justice of the producers' profits. For this latter purpose the most satisfactory index is the average realization rather than the spot or market price. The great bulk of soft coal is sold under contract. Contracts ordinarily run for a year, beginning with April 1, the opening of the "coal year," and sometimes for two, three, five, or even twenty years. Although such long-term contracts usually contain clauses automatically increasing the prices, in the event of wage increases, the price charged per ton is much lower than the ordinary market price. The test of the operator's profit is, therefore, not the spot price which, during periods of scarcity, may be forced up to very high levels, but rather the average price of all of the coal which is marketed. The producers of coal have secured a temporary injunction restraining the Federal Trade Commission from imposing penalties for failure to supply monthly figures on realization and cost, but the Commission is still receiving a sufficient number of voluntary reports to enable it to keep up the record. As an index to the operators' return, these reports have great value and are properly to be considered as a part of the control statistics of the coal industry.

Quite apart from the social justice of a prevailing price of coal, prices have an immediate significance in coal distribution and consumption. The demand for coal is notably inelastic. As the ultimate source of most of our power and heat, it has no competitor or substitute on a large scale. In consequence even a slight maladjustment between demand and supply creates abnormal prices for free or non-contract coal. This principle is well illustrated by the experience of the spring and summer of 1920. During this season there have been few authenticated instances of plants actually closing down for lack of fuel, yet the difficulty of obtaining coal and the apprehension of a possible interruption of supply during the winter have induced purchasers to pay spot prices from 100 to 500 per cent above the government maximum. The minute prices reach such extravagant levels, inequalities and irregularities in the distribution of coal develop. Consumers, like public utilities, operating under a fixed return, cannot compete with

prosperous manufacturers who are able to increase the price of their product and with whom, as often happens, coal is a minor item of expense. Even the prudent consumer, whose requirements are covered by contract, finds difficulty in securing deliveries on the contracts he holds. The result is that in addition to the general draft upon stocks, which occurs in a time of scarcity, some consumers run out of their supply long before others, and if a tie-up of transportation occurs, occasioned perhaps by a great storm, the results are much more serious than if the same amount of coal had been evenly distributed among all consumers.

The price factor may even go so far as to divert streams of coal from one locality to another. An outstanding feature of the coal distribution in the first half of 1920 has been an increase in the relative movement to Detroit and the Southern Peninsula of Michigan. Michigan consumers were indeed in need of fuel. Their reserves had been eaten into during the coal strike of the winter of 1919 as severely as those in any locality. But when it came to bidding for the limited output of coal in the Northern and Middle Appalachian region, the prosperous automobile makers and their train of subsidiary industries were able to get more than their proportionate share at the expense of the movement up the Lakes to the Northwest. A still more outstanding illustration of the effect of prices upon distribution is the diversion for export overseas, of tidewater coal which normally would move to New England. It is no doubt just to say that when New England really needs the coal she will pay the price and keep it from moving abroad, but the fact remains that under the stresses set up by price differentials, a condition of temporary shortage more or less severe, affecting a whole locality, has been brought about.

These illustrations point to the necessity of adequate "records of prices," including prices for free coal and also average realization figures, as a part of a well-balanced system of control statistics of coal distribution.

NOTES

INTERNATIONAL PRICE INDEXES*

The *Federal Reserve Bulletin* for May contains a discussion of the method to be used in the construction of a series of international price index numbers by the Division of Analysis and Research of the Federal Reserve Board. A new index number for the United States, which is the first of the series, also is published in that number of the *Bulletin*. Index numbers for England, France, Italy, and Japan are in process of construction. The first two will probably be published in the autumn.

Method of Construction

Each index number is to consist of approximately ninety different wholesale price quotations, the commodities to be classified (1) according to their stage of manufacture, as raw materials, producers' goods, and consumers' goods, and (2) according to their derivation and use, as goods produced, imported, exported, and consumed. The year 1913 is used as the base year. No attempt has been made to cover the war period. The same method of weighting will be used in the case of each index number. Prices of goods produced will be weighted by the quantity produced, prices of goods imported by the quantity imported, etc. All of the indexes are being planned and the computations made in this country in order to insure uniformity of method. Actual prices are collected abroad by consular agents and cabled to the Federal Reserve Board the first of each month. The index numbers will be published monthly for the preceding month.

The plan outlined above was developed after considerable study of the problem, both as to the ends to be gained in making a series of foreign index numbers, and the best methods for reaching these ends. The aims are three: first, to obtain better and more comparable indexes of the general wholesale price levels of the leading foreign industrial countries; second, to increase our information regarding the movement of prices of goods entering into foreign trade; and third, to classify the material in such a way as to throw as much light as possible upon current business conditions abroad.

A study of the indexes currently published abroad showed that in most cases they consisted of the prices of not more than forty-five commodities, most of which were raw materials or in a very early stage of manufacture, that all of the commodities quoted were given equal representation in the index numbers regardless of their importance in the economic life of the countries concerned, and that in some cases import and export valuations were used in computing the umbers instead of wholesale market quotations. The year or series of years used as the base from which to measure price changes differed in every case, so that it was necessary to recompute the numbers to make them comparable.

Obviously such indexes were not satisfactory either for showing accurately

*The Division is indebted to Walter W. Stewart of Amherst College for making constructive suggestions regarding the organization and weighting of the index numbers.

the general price levels of individual countries or for making comparisons between countries. Improvement could be made in the following respects at least:

(1) By including a larger number of quotations.

(2) By including not only raw materials but semi-manufactured, and manufactured commodities in them.

(3) By weighting the commodities according to their industrial importance.

(4) By using wholesale market quotations collected from reliable sources.

(5) By using the same base year for all countries.

Scientific work done in the field of international price comparisons had emphasized the fact that for comparative purposes it was important to have all the indexes approximately the same size and based upon the prices of the same commodities. Experimentation showed that the first point was essential, *i. e.*, that the index numbers should all be of approximately the same size. Otherwise, an unnecessary element of dissimilarity was allowed to influence the comparisons. The second point, namely, that the same or similar commodities form the basis of all indexes, did not appear equally valid for the reason that all countries differ economically one from another, and no single list of commodities represents them all equally well. Carefully matched commodities are essential for the purpose of comparing actual prices from country to country; representative commodities, on the other hand, are preferable as a basis for index numbers.

Ninety quotations (the number allowed for each of the new indexes) provides representation for all of the leading commodities of a country, is small enough to be a fairly sensitive barometer of price changes, and is not unnecessarily expensive. Such a number is big enough to prevent one commodity, or a small group of commodities, from influencing the final index unduly. It also allows a fair representation to commodities in different stages of manufacture and of different derivation and use. In respect to size, it marks a considerable improvement over existing index numbers.

A year ago, when the international price indexes were first planned, it was thought unlikely that sufficient foreign statistical material could be obtained in this country to furnish a satisfactory system of weighting for the proposed index numbers. The desirability of weighting the commodities according to their importance in the different countries was generally conceded. Fortunately, however, foreign statistics for 1913 were available in larger quantities than was anticipated, and as a result the method of weighting has become one of the most important features of the new index numbers.

In order to carry out the second aim mentioned above, namely, that of making index numbers which would facilitate the study of prices in their relation to foreign trade, it was decided to classify the commodities as domestic goods, imported goods, and exported goods. The method of weighting adopted suits this purpose excellently, as the prices of domestic goods are weighted by the quantity of goods produced in 1913, the prices of imported goods by the quantity imported, the prices of exported goods similarly by the quantity exported, and the prices of goods consumed by the quantity consumed in that year. The general index is made by putting together the weighted prices of domestic goods and imported goods. In other words, the method of weight-

ing the all commodities index is that of production plus imports in 1913. The system of weighting may be expressed in the equation, goods produced + goods imported = goods exported + goods consumed.

An index number can be very quickly constructed and easily carried on if weighted in this fashion. Monthly index numbers are obtained by using the following formula:

Let p_0 = the price of wool in any month
p_1 = the price of hides in the same month
p_2 = the price of cotton in the same month
etc. for other commodities in the index
Let q_0 = the quantity of wool produced in 1913
q_1 = the quantity of hides produced in 1913
q_2 = the quantity of cotton produced in 1913
etc. for other commodities in the index
Let i_0 = the quantity of wool imported in 1913
i_1 = the quantity of hides imported in 1913
i_2 = the quantity of cotton imported in 1913, etc.
Let e_0 = the quantity of wool exported in 1913
e_1 = the quantity of hides exported in 1913
e_2 = the quantity of cotton exported in 1913, etc.
Let c_0 = the quantity of wool consumed in 1913
c_1 = the quantity of hides consumed in 1913
c_2 = the quantity of cotton consumed in 1913, etc.
Then Σ P Q = the sum of the prices in the chosen month of goods produced × the amounts produced
Σ P I = the sum of the prices in the chosen month of goods imported × the amounts imported
Σ P E = the sum of the prices in the chosen month of goods exported × the amounts exported
Σ P C = the sum of the prices in the chosen month of goods consumed × the amounts consumed
Or Σ P Q + Σ P I = Σ P E + Σ P C and the index numbers may be obtained by converting the money aggregates on both sides of the equation into relative numbers on the 1913 base.

The import and export classification is useful not only as showing the trend of prices in these two groups of goods, and thus throwing light on the relationship between foreign exchange, international trade, and prices, but it may be used also to correct the price factor in foreign trade statistics. The Federal Reserve Board has already begun to use the index numbers for the United States in this way, publishing for the first time in the *Bulletin* for July, 1920, a monthly index of the foreign trade of the United States based upon the trade in the commodities used in the export and import price indexes.

Classification of commodities according to stage of manufacture was made in order to facilitate the study of business conditions abroad, and to show the variations in the level of prices of raw materials, producers' and consumers' goods. This method of classification will probably be of more interest to the student of economic conditions than to the business man. For one reason, the significance of the variations in the prices of raw materials, producers' and consumers' goods,

and the meaning of the latter two terms are not generally understood. For the purpose of distinguishing between demand for goods for personal and family consumption and industrial demand either for equipment or raw materials, however, this classification is essential.

The American Index Number

A demonstration of the type of information to be obtained from the new foreign index numbers is furnished by the American numbers published below:

AVERAGE PRICES 1913=100

Date	Goods Produced (72 Quotations)	Imported (18 Quotations)	Exported (39 Quotations)	Consumed (88 Quotations)	Raw Materials (39 Quotations)	Producers' Goods (31 Quotations)	Consumers' Goods (20 Quotations)	All (90 Quotations)
1913								
January	100	105	100	100	99	105	99	100
February	100	104	100	101	99	105	99	100
March	100	103	99	101	100	105	99	101
April	101	101	99	101	101	103	99	101
May	100	100	99	100	100	102	99	100
June	100	99	100	100	100	101	101	100
July	100	99	99	100	98	101	102	100
August	100	101	99	101	101	100	101	101
September	101	100	102	101	102	98	101	101
October	101	98	103	100	102	96	101	100
November	99	98	102	98	100	95	101	99
December	98	93	99	97	98	91	99	97
1919								
January	197	168	200	195	195	193	196	195
February	191	168	192	190	190	191	188	189
March	193	163	194	191	196	185	188	191
April	198	155	194	196	201	181	197	196
May	204	172	211	201	209	184	202	202
June	204	180	214	202	208	192	202	203
July	214	176	224	211	217	200	211	211
August	221	174	219	218	217	206	224	218
September	215	170	212	211	211	203	216	212
October	215	174	226	212	213	207	214	211
November	222	179	242	217	220	213	219	219
December	231	205	249	225	223	223	225	226
1920								
January	244	212	255	240	245	236	240	242
February	244	216	252	242	242	247	240	242
March	250	218	256	247	246	263	241	248
April	265	242	264	263	263	274	257	263
May	266	246	262	264	263	274	261	264
June	261	226	256	258	258	265	256	258
July	255	204	248	251	250	251	254	251

Interesting factors in the general movement of wholesale prices in the United States since the armistice have been so frequently discussed that it is not necessary to go into the subject here. Although the Federal Reserve Board all commodities index runs considerably lower than that of the Bureau of Labor Statistics, the fluctuations in the two numbers are in substantial agreement. For some time past, the Federal Reserve Board has classified the commodities used in the index number of the Bureau of Labor Statistics into these three groups and has commented on the differences in their price fluctuations from time to time. As in the case of the all commodities index, the new numbers fluctuate in sub-

stantial agreement with those of the Bureau of Labor Statistics, but the percentages are likely to run lower. This is especially true in the case of consumers' goods. Why this difference in price levels exists requires a more detailed comparison of the two index numbers than we have as yet been able to make.

Although much has been written about prices recently, comparatively little attention has been given to the difference in the flucutation of prices of domestic goods as compared with imported, or of imported as compared with exported. In this field the new index makes a contribution to the study of American prices. Since the period covered by these indexes amounts to only eighteen months (not including the base year), no definite conclusions can be reached regarding the significance of the fluctuations. It is too soon to attempt to correlate them with foreign trade movements, fluctuations in foreign exchange, or volume of production. A brief summary can be given, nevertheless, of the outstanding features of the three curves during the period covered.

Eighteen quotations are included in the index of prices of imports, thirty-nine in that of exports. It is somewhat unfortunate that the import index is not larger, but in view of the fact that the value of imports in 1913 was only about three-fourths as great as that of exports and far less important as compared with domestic production, larger representations could not be given to imported goods. Sugar, coffee, tea, hides and skins, wool, silk, cotton, rubber, nitrate of soda, tin, lumber, and several less important commodities make up the index, and their combined value in 1913 was 41 per cent of the total value of imports in that year.

Fifty-six per cent of the value of our exports in 1913 is represented in the commodities included in the index of prices of exported goods. These include our leading cereal crops, tobacco, cotton, copper, coal, pig iron and steel products, lumber, oil products, pork products, leather and shoes, cotton cloth, coffee, and other goods of somewhat less importance for export.

Prices of seventy-two commodities form the index of goods produced. Thirty of these are raw materials. Farm products provided something over half the total value of the group in 1913, products of mines and forests making up the rest. Twenty-four of the seventy-two commodities in the index are producers' goods, a little over 50 per cent of whose value in 1913 was provided by equipment materials, the rest being made up of such goods as yarns, leather, semi-finished foods, etc. Of the eighteen consumers' goods in the index, twelve are foods, and the rest materials used for clothing and lighting.

Prices of Imports

January, 1919, to June, 1920, divides itself into three parts as far as import prices are concerned. The first period, lasting from January to September, 1919, was marked by a downward movement from January to March, a rise between March and June, followed by another reaction which left prices in September at approximately the same point as in January. Between September, 1919, and May, 1920, import prices steadily advanced, the increase amounting to as much, in terms of 1913 prices, as during the whole period of the war. The

index number stood at 170 in September and at 246 in May; in other words, prices of this class of goods increased about 45 per cent. May, 1920, marks another turning point, as prices in June showed a twenty point drop from those of May. In July there was a further decline of 22 points.

Falling prices from January to March, 1919, are easily accounted for by the industrial depression following the signing of the armistice. The revival during the next few months, however, was not so great as the revival in domestic and export prices, and the steady drop in import prices between June and September was of longer duration than was the case with domestic goods. This period is difficult to account for, as imports during the same time were rapidly mounting, showing that our demand upon foreign markets was on the increase. Certain important commodities continued controlled in price, however, and the demand for at least one of our leading imports, nitrate of soda, declined.

The phenomenal rise in prices between September and May was caused by our heavy demand for sugar, silk, hides, wool, etc., and the accompanying speculation in these commodities. Release of sugar from price control was another important factor in the situation. By May, 1920, however, there was no longer a market for several of these commodities, notably silk, hides, and wool, although sugar continued to advance; and by June practically every commodity which we import in quantity, including sugar, had declined in price.

A comparison between the prices of imported and domestic goods during the same period shows that imported goods were 68 per cent dearer in January, 1919, than in 1913. In the same month the prices of domestic goods were 97 per cent higher than in 1913. In other words, in January, 1919, the index number for imports was 17 per cent lower than that for domestic goods. By May, 1920, imported goods had advanced so rapidly that they were only 7 per cent less than domestic goods, but by July the old disparity in prices of the two groups had been re-established, the index number for imported goods being 25 per cent less than for domestic.

Why imported goods were and have continued considerably cheaper than domestic goods is probably to be explained by the fact that most of the materials in the index are obtained from markets where prices did not advance during the war at the same rate as in the United States or in Europe. Argentina furnishes us with wool and hides; Brazil with coffee and rubber; Chile with nitrate of soda; India with burlap; and other portions of the Far East with silk, tea, and tin; Australia with wool; the West Indies with sugar; and Canada with lumber. With the exception of Japan and Canada, probably none of these countries experienced such price increases as the United States between 1914 and 1919. In the case of rubber and coffee, conditions peculiar to the industries kept prices low during the war. New rubber plantations had just reached the productive period when war broke out, seriously curtailing European demand. Production could not be adjusted to the new conditions, and prices remained low. Inability to adapt production of coffee to war conditions kept prices of this commodity below pre-war levels. Price control, American and foreign, may have been more effective in the case of our imports than of our domestic goods, but as no studies have been made of this subject, it is impossible to be certain of it.

Prices of Exports

Export prices during the past eighteen months cannot be broken up into periods as neatly as import prices. After the depression of early 1919, they advanced rapidly until July, when a break came, the prices of cotton, wheat, corn, and other food products declining. From September until January prices rose even more rapidly than in the preceding spring, but in February a slight decline came again, this time in approximately the same commodities as during the summer before. Prices advanced again in March and April, but since then have been slowly falling.

Prices of export goods have been relatively higher than the average of domestic goods and the general price level most of the time between January, 1919, and June, 1920, although this has not always been the case. At the present time domestic goods and the general price level are relatively higher than exported goods. Although fluctuations in prices of export goods have usually preceded those of domestic goods as a whole, no general conclusion can be reached because of the shortness of the period and the peculiarities of trade during that time. As was mentioned above, the total rise in export prices between January, 1919, and May, 1920, was much less great than was the case with imported goods. The level of prices, as compared with 1913, was, however, both in January, 1919, and in June, 1920, very considerably higher than that of imported goods.

European and American war demand caused the prices of our export goods, which are some of our leading commodities for home consumption as well, to rise at a faster rate than imports. Prices of these and other important domestic goods had a far greater effect upon our general price level than prices of imports, as is shown by the similarity in the index numbers of goods produced and all commodities, and the dissimilarity between the latter and the index of imported goods.

Difficulty of Getting Material

Comparatively little difficulty was encountered in the construction of the American index number, as a great many prices have been collected by the Bureau of Labor Statistics and the Price Section of the War Industries Board, and as the latter organization has published considerable material regarding production and trade in individual commodities. With the foreign countries the situation is quite different. In the case of England and France a fairly large amount of material of a price and trade nature has been obtained. Even so, it has been necessary to apply to the foreign consuls for additional information. Price statistics and production estimates for highly fabricated commodities have had to be obtained direct from the industries concerned. Material available here regarding England and France is legion as compared with that for Italy. Although there is not much original Japanese price material here, official statistics showing the comparative importance of different industries and a good deal of expert advice regarding commodities can be obtained. On the whole, the construction of index numbers seems an entirely feasible undertaking for the countries so far studied, and probably will be in the case of Germany, Sweden, and Spain as well. It is, however, a tedious matter and will probably require a long time for completion.

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Federal Reserve Board.

RESULTS OF TWO YEARS' OPERATION OF THE LITERACY TEST FOR ADMISSION OF IMMIGRANTS

The illiteracy test clause of the Burnett-Smith Immigration Act of February 5, 1917, went into effect on May 5, 1917. Under the provisions of this act, all aliens over sixteen years of age, physically capable of reading who cannot read the English language or some other language or dialect, are excluded from admission to the United States. The main exceptions to this clause are: (1) that any alien admitted into this country, before or after the passage of this act, may bring in or send for his father or grandfather over fifty-five years of age, his wife, his mother, his grandmother, or his unmarried or widowed daughter, whether such relatives can read or not, and (2) that aliens who cannot read but who are seeking admission into the United States to avoid religious persecution in the country of their last permanent residence may be admitted.

The following table shows the results of the operation of the illiteracy test clause during the two fiscal years ending June 30, 1918 and 1919.

It will be seen that for some races, such as the Bohemian and Moravian, the Slovak, the Magyar, the Turkish, and the Croation and Slovenian, the total number admitted during the two years is small and that consequently percentages based upon these numbers are not so significant as are those based upon the larger totals of the other races.

The total number of all races debarred in the two years on account of illiteracy was 3,053, or 426 more than shown in the table. Of the 426 not included in the table, 302 were black Africans.

During the two years of the operation of the literacy test, 205,988 aliens were admitted to this country. The number debarred on account of illiteracy was 2,627, or 1.3 per cent of the total number admitted. Excluding the Mexicans, the percentages of all races debarred on account of illiteracy were 1.1 for the two-year period, and 1.2 and .9 for the years 1917–18 and 1918–19 respectively. From the spring of 1917 to June 30, 1919, 29,563 illiterate Mexican laborers were temporarily admitted to the United States under departmental exemptions. The percentages of Mexicans debarred do not, therefore, indicate the extent to which illiterates of this race applied for admission to this country during the two years covered.*

It will be seen that among the eleven racial groups having a smaller percentage debarred than the average for all races during the two years, four represent the new immigration, namely, the Finnish, the Spanish, the Portuguese, and the Hebrews. Of the races showing proportions debarred above 1.1 per cent, the French is the only one from northwestern Europe; while all the others (Mexicans excepted) are from southern and southwestern Europe. The races showing the highest percentages debarred on account of illiteracy are the Lithuanian, the Polish, the Bulgarian, Servian, and Montenegrin, and the Syrian. The Turkish shows the highest percentages debarred during the two years; however, it should be observed that this percentage is based upon a small number admitted. It is interesting to note that of the races showing the highest proportions de-

* Report of the Commissioner-General of Immigration, 1919, pp. 24–25.

barred for the two years, the Polish, the Bulgarian, Servian and Montenegrin, and the Syrian show smaller percentages debarred on account of illiteracy in 1918–19 than in 1917–18. Of the Polish, for instance, 13.4 per cent were debarred on account of illiteracy in 1917–18; while in 1918–19 only 5.2 per cent were debarred for the same cause. The proportion debarred for all races (not including Mexicans) was 25 per cent lower in 1918–19 than in 1917–18, the difference between nine-tenths of 1 per cent (0.9) and 1.2 per cent. Of the twenty-eight racial groups included in the table, fifteen show a decrease in the percentages debarred on account of illiteracy in 1918–19 as compared with 1917–18, nine show an increase, while four show no change. The two years' experience thus suggests the probability that the percentages debarred on account of illiteracy are likely further to decrease rather than to increase.

ILLITERATE ALIENS DEBARRED FROM ENTERING THE UNITED STATES DURING THE FISCAL YEARS 1917–18 AND 1918–19 COMPARED WITH THE PROPORTIONS OF ILLITERATES ADMITTED INTO THE UNITED STATES DURING THE PERIOD 1899–1917, BY RACES

Races	Total Admitted 1917–18 and 1918–19	Debarred Because Unable to Read (Persons 16 Years of Age and Over)				Per Cent Illiterates of Total Admitted 1899–1917[1]
		1917–18 and 1918–19		Per Cent of Total Admitted		
		Number	P. C.	1917–18	1918–19	
All Races[2]	205,988	2,627	1.1	1.2	.9	21.9
Welsh	886	...	....	....	....	1.1
Finnish	2,835	3	(a)	.1	.1	1.0
Norwegians, Danes and Swedes	17,002	3	(a)	....	(a)	.3
English	39,869	83	.2	.3	.2	.7
Scotch	15,568	29	.2	.2	.1	.4
Dutch and Flemish	4,935	20	.4	.5	.6	2.6
Spanish	12,133	44	.4	.4	.3	13.8
Irish	12,567	69	.5	.6	.5	1.9
Portuguese	3,893	24	.6	.6	.6	50.5
German	3,829	28	.7	.4	1.0	4.2
Hebrew	6,727	60	.9	1.0	.8	18.4
Armenian	503	6	1.2	2.2	.4	20.5
Italian, North	2,310	36	1.6	1.4	1.6	8.8
Slovak	120	2	1.7	2.8	1.2	20.0
Greek	3,415	60	1.8	1.5	2.5	23.3
Mexicans[3]	46,446	949	2.0	2.2	1.9	36.9
Bohemian and Moravian	179	4	2.2	2.7	1.9	1.2
French	19,438	571	2.9	2.9	2.9	5.9
Italian, South	7,371	217	2.9	2.6	3.5	45.3
Magyar	84	3	3.6	3.1	3.8	9.7
Roumanian	244	11	4.5	2.5	7.9	33.1
Russian	3,045	154	5.1	5.6	4.5	34.2
Croatian and Slovenian	56	3	5.4	6.0	4.3	31.1
Lithuanian	295	27	9.1	7.4	10.6	45.4
Polish	1,400	128	9.1	13.4	5.2	31.2
Bulgarian, Servian and Montenegrin	355	36	10.1	16.0	5.8	36.2
Syrian	441	49	11.1	19.0	3.9	43.4
Turkish	42	8	19.0	4.1	38.9	57.9

[1] Illiterates during 1899–1917 are immigrants, both sexes, fourteen years of age and over, who can neither read nor write. The percentages are of the total number admitted, not of the total number admitted who were fourteen years of age and over. If the latter percentages were calculated, they would obviously be higher, but not much so because of the fact that comparatively few of the immigrants are below the age of fourteen upon their arrival.

[2] The percentages debarred for all races do not include Mexicans.

[3] Since the spring of 1917, 29,563 Mexican laborers were admitted to the United States who were exempted from the literacy test. See Report of Commissioner-General of Immigration to the Secretary of Labor, 1919, p. 25.

(a) Less than one-tenth of 1 per cent.

During the period 1899–1917, 13,821,126 immigrants from the races shown in the table were admitted into the United States. Of this number 3,029,752, or 21.9 per cent were illiterates who could neither read nor write. It goes without saying that the illiteracy clause above referred to did not reduce the proportions of illiteracy among the several races studied. It is evident that the effect of this clause has been to reduce considerably the numbers of illiterates seeking admission into this country. The Portuguese and the South Italians furnish a striking example of this. Over 50 per cent of the Portuguese admitted during 1899–1917 were illiterates; while during the two years studied only .6 per cent were excluded from admission on account of illiteracy. Of the South Italians 2.9 per cent were refused admission on account of illiteracy during 1917–18 and 1918–19, whereas during 1899–1917 over 45 per cent of the total admitted of this race could neither read nor write. The Polish, the Bulgarian, Servian, and Montenegrin, and the Syrian do not show the same reductions in the proportions of illiterates seeking admission as are shown by any of the other races exhibited in the table.

It will be noticed that the Bohemian and Moravian is the only race which shows a proportion of illiterates debarred during 1917–18 to 1918–19 which is higher than the proportion of illiterates admitted during 1899–1917. However, it should not be overlooked in this connection that the percentage of the Bohemian and Moravian debarred during this period is based on the small number admitted.

An examination of the figures in Table XVII of the Reports of the Commissioner-General of Immigration for 1918 and 1919 shows that illiteracy as a cause for exclusion from admission during the two-year period was next in importance only to the cause "likely to become a public charge." The number rejected for illiteracy was about 19 per cent of the total number debarred for all other thirty-four causes mentioned in the Reports of the Commissioner-General of Immigration.

An analysis of the data presented in the table leads to the following conclusions in regard to the effect of the operation of the illiteracy test during the first two years: (1) It has considerably reduced the proportions of illiterates seeking admission into this country, though not to the same extent among all races; (2) the proportions debarred on account of illiteracy are likely further to decrease rather than to increase; and (3) illiteracy, compared with other causes for exclusion from admission, is very important.

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STATISTICS OF COLLEGE GRADUATES

The following paper gives the results of a study of American statistics of collegiate and professional education with two objects in view: first, to estimate the number of male college graduates in the country at various dates holding degrees of A.B., B.S., Ph.B., or B.L., and the proportion of males over

twenty-two years of age who held such a degree; and secondly, to estimate the number of graduates in the country at various dates holding degrees of law, medicine, or theology and to compare them with the reported number of lawyers, doctors, and clergymen.

The best source of information regarding the number of degrees of various sorts conferred each year in the United States is the annual reports* of the United States commissioner of education. From these reports my material is taken.

The problem of determining the number of men living at any particular date holding an A.B., B.S., Ph.B., or B.L. degree divides itself into two parts: first, how many men have received such degrees, and secondly, how many of them survived to a specified date. The reports of the commissioner of education contain figures for the annual number of male graduates only for the years 1880 to 1914 inclusive. The figures for years subsequent to 1914, though given, were classified differently from those of the preceding years, and in consequence it seemed best to make estimates for these years. The rate of increase of the five-year-period 1915 to 1919 over that of 1910 to 1914 was assumed to be the same as the rate of increase for the period 1910 to 1914 over that of 1905 to 1909. Applying this percentage to the figure for 1910 to 1914 gave the estimated figure for the period 1915 to 1919.

In order to obtain a basis for estimating the number of graduates in each year prior to 1880 the following test was made: figures were estimated for the years

TABLE I

ESTIMATED AND ACTUAL NUMBER OF GRADUATES 1891–1900

Year	Reported Number Graduating	Estimated Number Graduating Based on			Per cent Deviation
		Arithmetic Rate of Increase as of 1900 to 1910	Per cent Deviation	Geometric Rate of Increase as of 1900 to 1910	
1900	8,003	8,266	3.29	8,338	4.19
1899	7,764	7,734	.38	7,900	1.75
1898	7,305	7,202	1.41	7,486	2.48
1897	7,051	6,670	5.40	7,093	.60
1896	6,831	6,138	10.15	6,720	1.62
1895	6,376	5,606	12.07	6,367	.14
1894	5,803	5,074	12.56	6,036	4.01
1893	5,793	4,542	21.61	5,719	1.28
1892	5,514	4,010	27.26	5,419	1.72
1891	5,273	3,478	34.04	5,125	2.81
Average percent deviation			12.82		2.06

1890 to 1900 by working backward from 1900, using both the arithmetic and geometric rate of increase for 1900 to 1910. Table I clearly shows that the geometric rate gives the better approximation to the facts.

A further study of the reported figures for the years 1880 to 1910 reveals the fact that the rate of increase is itself increasing. Thus the rates of decennial

* In respect to the trustworthiness and completeness of his figures, the present commissioner of education in a letter to the writer says that in his opinion they are as trustworthy as could be obtained, and that "the institutions which failed to report to this office would probably not average more than ten, and they would represent as a rule the smaller institutions."

increase 1880 to 1890, 1890 to 1900, and 1900 to 1910 were 3¼ per cent, 4½ per cent and 5¼ per cent respectively. In view of this fact the rate for the ten years 1880 to 1890 seemed the best to apply to years prior to 1880, and the figures used are based upon this 3¼ per cent rate.

In order to estimate the number of graduates living at any particular date as shown in Tables V, VI, VII and VIII, the life table* for males in the original registration area for 1909 to 1911 was used. It was assumed that the average age of graduation is twenty-two years, and thus the 77,974 men shown by that life table as living at that age were considered as the base, or 100 per cent. By dividing the number living at each succeeding year by this number, percentages are obtained showing the proportion of these 77,974 men who would be living at each succeeding year of age. Applying these percentages to the number of graduates for the various years gives the number living at each year of life.

The fact of especial significance brought out by the figures in the first column of Table V is the rapidly increasing number of graduates turned out annually by our colleges and universities. More than half of the 496,618 degrees granted since 1815 have been conferred since 1900, and of the 358,026 male college graduates living June 1, 1920, over half received their degrees after 1905. Thus the majority of the college trained men of today are under 37 years of age, and have not yet reached the full fruition of their power and training. Though the last decade has witnessed the most marked increase in the annual number of graduates of our colleges and universities, yet this same tendency is noticeable throughout each period for which figures are obtainable. The number of male college graduates per 100,000 males over twenty years of age for the last five census dates are as follows:

TABLE II

RATIO OF COLLEGE GRADUATES TO POPULATION

Census Date	Living Male College Graduates per 100,000 Males Over 20 Years of Age
1880	687
1890	710
1900	745
1910	874
*1920	1137

*It is assumed that the increase of the male population over twenty years of age for the decade 1910 to 1920 was by the same amount as that for the decade 1900 to 1910.

In studying the professional degrees granted by universities and professional schools, the same general method of analysis was followed. Tables VI, VII and VIII show by five year periods the results of these computations for graduates in law, medicine, and theology. From 1815 through 1919 our law schools have graduated 138,603 men, our medical schools 236,318, and our theological schools 80,951. The most striking fact shown by these figures is the rapidly decreasing number of medical graduates. The estimated number of degrees granted by medical schools in the period 1915 to 1919 was less than in any previous quinquennial period subsequent to the period 1875–1880. Since the year 1904,

*Bureau of Census of United States Life Tables: 1910, pp. 18 *et seq.*

when 5,702 received medical degrees, there has been an almost steady falling off in the number of medical graduates. The same tendency is noticeable in respect to the students in attendance, there being in 1903, 27,062 students enrolled in medical schools, while in 1915 this figure was only 15,000.

Among the reasons for this decrease as stated by the commissioner of education in his report of 1909 are: (1) The increased rigor of state and college requirements; (2) the adoption of the four year course by most schools; and (3) much severer college entrance requirements. Modern medical education is becoming more costly because of the time that must be spent in training and because of the actual money outlay. Expensive laboratories must be established and maintained and abundant hospital facilities provided.

A second striking fact to be derived from these statistics is the rapidly increasing ratio of college trained physicians to total practitioners given by the census. The number of physicians holding a medical degree per 1,000 practising physicians for the census dates 1880, 1890, 1900, and 1910 has been 591, 757, 885, and 952 respectively. Though the ratio of total physicians per 100,000 population has remained about the same during this period, being for these dates 171, 167, 174, and 172 respectively, that for physicians with a degree from a medical college has shown a steady increase, being for the same dates 101, 126, 153, and 163 respectively. We have relatively no more physicians today than we had a generation ago, yet the figures indicate that those we do have are better trained than those who attended our parents.

This same tendency is shown in regard to lawyers and clergymen although to a less marked degree, as the following table indicates:

TABLE III

RATIO OF COLLEGE-TRAINED TO TOTAL LAWYERS AND CLERGYMEN

Year	Practitioners With a Professional Degree per 1,000 Total Practitioners	
	Lawyers	Clergymen
1880	294	256
1890	286	263
1900	400	312
1910	595	423

The number of lawyers and clergymen per 100,000 population is shown by the following table:

TABLE IV

RATIO OF LAWYERS AND CLERGYMEN TO POPULATION

Year	Total Practitioners		College-Trained Practitioners	
	Lawyers	Clergymen	Lawyers	Clergymen
1880	128	129	38	33
1890	143	140	40	36
1900	151	147	60	45
1910	133	163	79	49

Probably the main reason for the increasing proportion of medical and legal students who receive their training in universities and professional schools lies in the increasing rigor of state examinations. This is particularly true in the medical profession where great strides have been made in the last generation along the line of state supervision. In the report of 1880 the commissioner of education wrote, speaking of the medical profession: "The profession has been overcrowded for many years chiefly because of the scandalous ease with which men imperfectly educated or not educated at all have been able to assume its titles and duties."

TABLE V

MEN HOLDING AN A.B., B.S., PH.B., OR B.L. DEGREE

Year	Number Graduating	Those Living on June First				
		1920	1910	1900	1890	1880
*1915–19	95,159	93,611				
1910–14	71,515	68,249				
1905–09	54,190	49,805	53,290			
1900–04	45,172	39,598	43,117			
1895–99	35,327	29,253	32,461	34,743		
1890–94	27,411	21,154	24,015	26,154		
1885–89	26,157	18,429	21,643	24,023	25,663	
1880–84	23,293	14,457	17,971	19,911	22,223	
*1875–79	19,567	10,118	13,794	16,196	17,970	19,240
1870–74	16,797	6,706	10,421	12,957	14,717	16,025
1865–69	14,417	4,045	7,456	10,165	11,933	13,245
1860–64	12,373	1,924	4,938	7,677	9,545	10,840
1855–59	10,820	677	2,907	5,491	7,487	8,791
1850–54	9,110		1,417	3,637	5,651	7,022
1845–49	7,813		527	2,139	4,039	5,508
1840–44	6,703			1,002	2,675	4,159
1835–39	5,750			390	1,573	2,973
1830–34	4,925				765	1,967
1825–29	3,380				285	1,156
1820–24	3,627					564
1815–19	3,112					211
Total	496,618	358,026	233,957	164,485	124,526	91,701

* Figures for the number of graduates prior to 1880 and for the period 1915–19 are estimates.

In addition to the increasing rigor of state bar examinations many students are undoubtedly being sent to law schools through their inability to secure adequate legal training in the offices of practitioning attorneys. Regarding this the late Chief Justice Waite said: "The time has gone by when an eminent lawyer, in full practice, can take a class of students into his office and become their teacher. Once that was practicable, but now it is not. The consequence is that the law schools are now a necessity."

An interesting relationship seems to exist between the law and medical graduates. Since 1904 the annual increase in the number of law graduates roughly equals the annual decrease in the number of medical graduates. In 1910 there were 5,555 fewer medical students than in 1904, while there were 5,261 more law students. This relationship is quite natural, for while medical college requirements are becoming increasingly difficult, law college requirements show the opposite tendency. Thus in 1880, in order to enroll in the Columbia Law School one had to pass examinations in Roman, English, and United States his-

TABLE VI

PERSONS HOLDING DEGREES CONFERRED BY LAW SCHOOLS

Year	Number Graduating	Those Living on June First				
		1920	1910	1900	1890	1880
*1915–19	24,031	23,632				
1910–14	21,451	20,464				
1905–09	17,985	16,524	17,686			
1900–04	16,851	14,756	16,072			
1895–99	14,919	12,350	13,705	14,669		
1890–94	9,981	7,724	8,765	9,536		
1885–89	5,080	3,597	4,217	4,674	5,001	
1880–84	4,755	2,933	3,656	4,157	4,530	
*1875–79	4,646	2,408	3,279	3,849	4,272	4,569
1870–74	3,670	1,467	2,279	2,831	3,216	3,502
1865–69	3,025	829	1,566	2,133	2,505	2,779
1860–64	2,497	390	998	1,649	1,926	2,188
1855–59	2,057	140	563	1,065	1,451	1,703
1850–54	1,697	28	264	677	1,053	1,308
1845–49	1,403		95	384	725	988
1840–44	1,161		14	182	464	872
1835–39	961			65	264	497
1830–34	795				124	317
1825–29	655				45	178
1820–24	540					85
1815–19	443					29
Total	138,603	107,251	73,159	45,871	25,576	18,864

* Figures for the number of graduates prior to 1880 and for the period 1915–19 are estimates.

TABLE VII

PERSONS HOLDING DEGREES CONFERRED BY MEDICAL SCHOOLS

Year	Number Graduating	Those Living on June First				
		1920	1910	1900	1890	1880
*1915–19	16,855	16,558				
1910–14	20,165	19,252				
1905–09	25,013	22,945	24,572			
1900–04	27,073	23,718	25,825			
1895–99	25,846	21,388	23,735	25,411		
1890–94	23,323	17,982	20,427	22,245		
1885–89	19,987	14,095	16,543	18,358	19,647	
1880–84	16,966	10,521	13,085	14,862	16,185	
*1875–79	13,655	7,080	9,640	11,314	12,550	13,433
1870–74	10,431	4,172	6,478	8,051	9,142	9,952
1865–69	8,283	2,275	4,289	5,843	6,863	7,612
1860–64	6,581	1,028	2,631	4,088	5,078	5,768
1855–59	5,225	355	1,435	2,706	3,686	4,328
1850–54	4,149	87	649	1,659	2,577	3,202
1845–49	3,292		224	905	1,704	2,322
1840–44	2,613		50	409	1,046	1,622
1835–39	2,075			141	571	1,075
1830–34	1,644			28	256	657
1825–29	1,302				96	358
1820–24	1,033					162
1815–19	816					56
Total	236,318	161,456	149,583	115,020	79,401	50,547

* Figures for the number of graduates prior to 1880 and for the period 1915–19 are estimates.

TABLE VIII

PERSONS HOLDING DEGREES CONFERRED BY THEOLOGICAL SCHOOLS

Year	Number Graduating	Those Living on June First				
		1920	1910	1900	1890	1880
*1915–19	10,175	10,007				
1910–14	9,440	9,004				
1905–09	8,147	7,485	8,009			
1900–04	8,179	7,159	7,799			
1895–99	8,338	6,900	7,658	8,198		
1890–94	7,030	5,423	6,159	6,706		
1885–89	5,113	3,619	4,242	4,704	5,032	
1880–84	3,737	2,317	2,883	3,272	3,565	
*1785–79	3,784	1,950	2,663	3,127	3,472	3,719
1870–74	3,465	1,384	2,151	2,673	3,036	3,306
1865–69	2,815	772	1,456	1,985	2,331	2,586
1860–64	2,289	357	915	1,421	1,765	2,005
1855–59	1,864	126	510	964	1,314	1,544
1850–54	1,518	25	237	607	943	1,171
1845–49	1,236		89	337	640	872
1840–44	1,006			158	401	623
1835–39	816			56	223	423
1830–34	663				105	264
1825–29	538				36	146
1820–24	438					68
1815–19	360					25
Total	80,951	56,528	44,771	34,208	22,863	16,752

* Figures for the number of graduates prior to 1880 and for the period 1915–19 are estimates.

tory, Greek, Latin, and Rhetoric. Compare these requirements with the following quotation from the 1910 report of the commissioner of education: "In the 114 legal institutions with the exception of the law departments of about one dozen universities admission is readily granted to graduates of high schools. About one-quarter of the law schools allow graduation after two years of attendance and two schools grant degrees after only one year of attendance."

One cannot but be impressed in studying these figures by the increasing importance of the college-trained man in the professions. More and more he is becoming the dominating figure among professional men. In 1880, 59 per cent of our physicians held a medical degree, while in 1910, 95 per cent of them had received this degree. Apparently our health is better attended to than either our property or spiritual welfare, yet these last two professions show the same increasing dominance of the college-trained man.

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THE BEST INDEX OF BUILD

Robustness is a rough index of health. Since the weight of men varies with their height, the mere weight is of little use as an index of robustness, and just how robustness may be best expressed quantitatively is a matter of doubt. The naive procedure is to divide the weight by the height, but this has the serious objection that while height is a linear dimension, weight is really a volumetric dimension. Were men approximately cylinders of different height, then the weight divided by the height would give an appropriate index of

build; but obviously the hypothesis is not in accordance with the facts. It has sometimes been urged that since bodies of the same shape but of different size vary in volume as the cube of any diameter, that weight should be divided by the cube of height in order to secure index of build; but the hypothesis that men of different stature are of the same form is also not justified; for tall men have a prevailingly slender build and short men are on the average stockier. Nevertheless, the method of securing a measure of build by dividing weight by the cube of the height has been extensively used and is urged by Professor C. R. Bardeen in a recent publication (Number 272) of the Carnegie Institution of Washington.

A test of the best method of measuring build may be made as follows: An extensive table of army measurements shows that the commonest stature is 67 inches, that the commonest combined units of stature and weight are the group 67 inches tall and 137 pounds in weight. The quotient for this modal class of

$$\frac{137 \text{ pounds}}{67 \text{ inches}}$$

is, in the case of the first power of 67, 2.045; for one hundred times the quotient obtained by using the second power as a divisor, 3.052, and for 10,000 times the quotient obtained by using the third power of 67 as a divisor, 4.555. By taking now a series of combinations of weight and height in each of which there is found at least 1 per cent of men as measured in the army draft, we secure a series of fractions in which the numerator is the weight in pounds and the denominator the height in inches. The selected measures are:

$$\frac{117}{63}, \frac{127}{63}, \frac{117}{65}, \frac{127}{65}, \frac{137}{65}, \frac{117}{67}, \frac{127}{67}, \frac{147}{67}, \frac{157}{67}, \frac{127}{69}, \frac{137}{69}, \frac{147}{69}, \frac{157}{69}, \frac{147}{71}, \frac{157}{71}, \frac{167}{71}.$$

These relations were worked out by using the weight in pounds as the dividend and by using as a divisor in turn the first power, the second power, and the third power of the height in inches. From each of the quotients in which the first power of the height was used as a divisor there was obtained the deviation from 2.047; the deviation from 3.052 was obtained from each of the quotients when the second power was used as a divisor; and the deviation from 4.555 when the third power of the height was used as a divisor. The sum of the deviations disregarding signs was, when the first power was used as a divisor, 2.587. Divided by the reference standard of 2.045, this gives 1.265, which is the *relative* variability of the sixteen group combinations as obtained by using the first power of the height as a divisor. By using the second power of the height as a divisor, the corresponding figure is 1.146; by using the third power as a divisor, it is 1.237. Hence, the outlying groups give the smallest deviation from the condition found in the central group when the second power of the height is used as a divisor.

In still another way can we show that by using the second power of height as a divisor better results are obtained than by using the first or the third power. As is well known, shorter men are on the average more robust than tall men. By calculating the ratios for shorter and taller men of the same average weight with the use of the first, second, and third powers of height respectively, we secure the results indicated in Table I.

TABLE I

SHOWING (A) THE WEIGHT AND HEIGHT FOR WHICH THE WEIGHT-HEIGHT INDEX IS CALCULATED; (B) THE CORRESPONDING INDEX WHEN THE FIRST POWER OF HEIGHT IS USED; (C) THE CORRESPONDING INDEX WHEN THE SECOND POWER OF HEIGHT IS USED; (D) THE CORRESPONDING INDEX WHEN THE THIRD POWER OF HEIGHT IS USED

(A)	(B)	(C)	(D)
$\frac{117}{61}$ $\frac{117}{66}$ $\frac{117}{70}$	1.92 1.77 1.67	3.14 2.69 2.39	5.16 4.07 3.41
$\frac{127}{62}$ $\frac{127}{67}$ $\frac{127}{71}$	2.05 1.90 1.79	3.30 2.30 2.52	5.33 4.22 3.55
$\frac{137}{63}$ $\frac{137}{68}$ $\frac{137}{72}$	2.18 2.01 1.90	3.45 2.96 2.64	5.48 4.36 3.67
$\frac{147}{64}$ $\frac{147}{69}$ $\frac{147}{73}$	2.30 2.13 2.01	3.59 3.09 2.76	5.60 4.47 3.78
$\frac{157}{64}$ $\frac{157}{69}$ $\frac{157}{73}$	2.45 2.28 2.15	3.83 3.3 2.95	5.99 4.79 4.04
$\frac{167}{65}$ $\frac{167}{70}$ $\frac{167}{74}$	2.57 2.39 2.26	3.95 3.41 3.05	6.08 4.87 4.12

From this table it appears that when the first power of height is used in the ratio, the increase in robustness of abmodally short men over abmodally tall men is about 10 per cent; with the second power it is about 30 per cent; with the third power it is about 50 per cent. It is quite clear that the shorter men are not 50 per cent more robust on the average than the tall men, though opinion may be divided as to whether a 30 per cent or a 10 per cent increase more nearly agrees with the general impression obtained by observing a number of men 4 inches above the mean as compared with the number of men measuring 5 inches below the mean stature.

In still another respect does the use of the square of the height in determining the build show its superiority as a measure over the first and second power of height. Thus if we start with the data given in Bardeen's Table E, which in turn is based on one of Quetelet's (1870), we may compare the coefficients of build for different years of development from one to thirty, and we may compare the coefficients of build as obtained by calculating the ratio of weight to the first power of height, to the second power of height, and to the third power of height, respectively, for each year. We then select some median age at a point of departure and for this purpose we select twelve years. We then find the deviations of the respective ratios from the twelve-year ratio and divide the average deviation by the first year ratio in order to secure a coefficient referred to the appropriate standard. In consequence of the suggestion made by Quetelet, it is worth while to calculate also the ratio of weight to the $2\frac{1}{2}$ power of height and to find the corresponding coefficient.

The suggested calculations have been made and are given in Table II. The first column gives the age in years of the group measured, the second column

TABLE II

DEVIATIONS OF WEIGHT-HEIGHT INDEXES FROM 12 YEAR RATIO

	$\frac{\text{Weight}}{\text{Height}}$	$\frac{\text{Weight}}{\text{Height}^2}$	$\frac{\text{Weight}}{\text{Height}^3}$	$\frac{\text{Weight}}{\text{Height}^{2\frac{1}{2}}}$
12 year ratio	210.909	1.5339	.1116	.13081
Birth	148.909	.2939	.1364	.04455
1 yr.	82.024	.3134	.1530	.09030
2 yr.	71.845	.2242	.1107	.06686
3 yr.	66.233	.1405	.0822	.04934
4 yr.	59.885	.0952	.0641	.03840
5 yr.	49.815	.0983	.0538	.03348
6 yr.	40.737	.0930	.0439	.02826
7 yr.	32.567	.0724	.0348	.02362
8 yr.	25.023	.0659	.0261	.01756
9 yr.	17.970	.0502	.0185	.01272
10 yr.	12.952	.0212	.0106	.00702
11 yr.	6.137	.0040	.0045	.00279
12 yr.				
13 yr.	21.698	.1007	.0033	.00622
14 yr.	31.643	.1853	.0054	.01110
15 yr.	61.398	.2659	.0074	.01551
16 yr.	81.240	.3461	.0094	.02000
17 yr.	100.885	.4222	.0111	.02412
18 yr.	119.766	.4948	.0129	.02809
19 yr.	137.127	.5691	.0155	.03266
20 yr.	145.378	.5996	.0162	.03428
25 yr.	182.670	.8061	.0175	.04961
30 yr.	181.143	.7914	.0263	.04827
Total deviation	1677.035	6.0534	.8636	.68476
Average deviation	76.229	.2752	.03925	.031125
Average deviation divided by 12 year ratio	.3614	.1794	.3517	.2379

gives the ratio of weight to the first power of height, and the succeeding columns the ratios of weight to the second, third, and $2\frac{1}{2}$ powers of height respectively. The ratio for twelve-year old persons is given in the first line, and in the subsequent lines are given the deviations from the twelve-year old ratio. At the bottom is given the average deviation for all the ages from the twelve-year old ratio, and in the line below that, the relative deviation as obtained by dividing the average deviation by the twelve-year old ratio. One sees that in the relative average deviations the worst result is given by the use of the first power of the height, the next poorest by using the third power, the next by using the $2\frac{1}{2}$ power. The smallest average deviation from the assumed standard is given by dividing weight by the second power of the height.

From these different tests, therefore, we draw the conclusion that the best index of build is the weight divided by the square of the height. The theoretical justification for this lies in the fact that since men do not vary in volume by the first power of height like cylinders of the same diameter, nor like spheres by the cubes of height, but in a manner intermediate between the two, so that we may expect to find the appropriate divisor for the index of build not the first power or the third power, but some intermediate power, and apparently the second power of height shows its superiority to either of the others and even to the $2\frac{1}{2}$ power. It is on this account that the best single index of build is secured by dividing weight by the square of stature.

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FAMILY STATISTICS IN NEW ZEALAND

Certain data in regard to families are normally secured in all countries. The information regarding the origin of families is contained in marriage statistics; birth statistics show the progress of the increase in size of families, and the breaking up of families is shown by the statistics of divorces and by those of deaths of married persons. In census, as distinguished from registration statistics, the material presented usually includes marital or civil condition of population and frequently the number and size of families or households.

New Zealand, for many years, has published as part of her registration statistics, tables showing the number of widows and orphans left by the breaking up of families by death, in correlation with the ages of the fathers. The original data were secured by an additional question put on the death certificates in which the number and ages of the surviving members of the family were secured. The value of this information in connection with nation-wide provision for dependents of soldiers killed in war can easily be understood.

This new departure in vital statistics has now been followed by a detailed analysis of families and households existing at the date of the census of 1916.* Households are divided into those inhabiting private dwellings and tenements and other households, and the first group is made the subject of special analysis. Tables are shown classifying heads of households by sex and marital condition, age, and by number of persons, number of adults, number of children under fourteen, number of breadwinners, and number of non-breadwinners in the household.

Among the population 1,099,449 found at the census of October, 1916, there was a total of 238,066 households inhabiting private dwellings and tenements. Of these households 204,373 had male and 33,693 had female heads.

Ten per cent of the heads of households had never married. About half of these were persons living alone; in only 1,861 cases, or less than 1 per cent of the total number of families, were there children under fourteen in the family. This number would doubtless include some who had been forced to assume the responsibility of caring for a family, the children of which had been orphaned and left without their natural fathers and mothers; they would perhaps include a few unmarried mothers, although many of this group might be returned as married.

The marital condition of the heads of a small number of families, 1,566, was not stated. Of 211,633 families whose heads were either married, widowed, or divorced, 182,199 were reported headed by males and 29,434 headed by females. The normal family group with father and mother living would be included, in the main, in the group with male heads.

In the consideration of those families in which the head was a male, a point of some interest is distribution by number of breadwinners. A small number, 729, were reported as having no breadwinner. The great majority, or 56.8 per cent, had only one breadwinner each; nearly one-fourth reported two breadwin-

*Results of a census of the Dominion of New Zealand taken for the night of the 15th October, 1916, Part XII, Households, Malcolm Fraser, Government Statistician, Wellington, by authority Marcus F. Marks, Government Printer, 1918.

ners each, and one-tenth reported three breadwinners each. The average number of breadwinners per family headed by males in this group was 1.7.

The average number of non-breadwinners in families headed by male heads is found to be 2.9. The tables also give separately by cities and the rest of the Dominion the relative proportions in the family between the breadwinners and the non-breadwinners.

In regard to the number of children under fourteen living in these families, it appears that slightly over one-third of these families had no children living with them; somewhat over one-fifth had one child each; one-sixth had two children each; nearly one-eighth had three children each; not quite one-twelfth had four children each; and not quite one-twelfth had more than four children each. Among the entire group the average number of children per family was 1.6. In families which had one or more children, the average number of children was 2.4. Of course these figures do not represent the number of children which these families would ultimately have, since in the families in the group taken are included the newly established families as well as those that have lasted for many years. The figures present rather a picture of the distribution of families according to the number of children at a given time.

Besides the families headed by males, there were 29,434 families whose heads were married, widowed, or divorced females. On an average, in these families there were 1.1 children per family with a female head. Slightly over half, however, reported no children at all. For families in which children were reported living, there were 2.3 children on an average. It appears on comparison with similar families headed by males, that the average number of children is somewhat less in this group than in the other group.

Over half, or 57 per cent, of the group reported themselves widows. Two-thirds of this number reported no children living with them, and among the remainder the average number of children living with them was 2.0. It appears, then, that the average number of children living with widows is somewhat less than the number of children living in a normal family headed by a married man. The average age of the widows was about sixty-one years.

The group includes, besides the widows and the divorced, 12,316 females who reported themselves as married. The significance of this group is a little doubtful since the ordinary family, with both husband and wife living, would be reported as with a male head. On analysis, it appears that in nearly half of these families the head of the household was the only adult. The average age of these married females, heads of families, appears to be considerably lower than the average age of widows. Probably the great majority were wives of soldiers away at the front.

Other groupings are also made of the data. Heads of households are classified by economic status, whether employer or working for wages. The wage-earning group, including those unemployed, amounted to 112,000, while the group of employers and those in business or working on their own account, included 84,000 or four-fifths as many.

Heads of households are also classified by home ownership. In the entire group, 112,000 were owners of freeholds—about half unencumbered and about

half mortgaged. About 12,000 more were buying their homes on time payments. Ninety-nine thousand were renting their homes. In 15,000 cases this information was not reported.

The proportion of wage-earners who were renting their homes was much higher, 53 per cent, than the proportion of employers who were renting, only 25 per cent. Of persons in business or working on their own account, not employing others, a slightly larger proportion (30 per cent) than of employers, were renting their homes.

Other tables show the economic status in relation to the renting value of the home and the size of the household in connection with home ownership.

It is to be regretted that the tables are published without critical and analytical text. The material would be very much more useful if the statistical definitions of units and cautions in regard to the interpretation of the figures were given. It should be mentioned, however, that summaries of the principal statistical results of census as well as registration statistics are published in the official year books.

ROBERT M. WOODBURY.

FEDERAL RESERVE BOARD'S INDEXES ON CONDITION OF RETAIL TRADE

It has long been recognized that the condition of retail trade constitutes a valuable indication of the probable changes in business weather. Nevertheless, it has been the custom in current trade periodicals for the situation in retail trade to be reported in highly subjective and descriptive terms, that is to say, by such words as poor, fair, good, very good, etc. It was for the purpose of rendering current reports of the condition of retail trade in as objective terms as possible that the Division of Analysis and Research of the Federal Reserve Board undertook, through the Federal Reserve agent's department of each of the Federal Reserve banks, to compile and publish monthly statistics designed to reflect the condition of retail trade throughout this country. For this purpose the large department stores in the more important cities throughout the United States were chosen as a source of information. The data compiled each month are as follows:

1. (A) Net sales (selling price) for current month as compared with same month last year.

(B) Net sales (selling price) for current season to date (seasons begin January 1st and July 1st) as compared with similar period the previous year.

2. (A) Stocks (selling price) on hand at end of current month as compared with stocks at end of same month last year.

(B) Stocks (selling price) on hand at end of current month as compared with stocks on hand at end of previous month.

3. Ratio between average stocks on hand at end of each month during the current season (seasons begin January 1st and July 1st) and net sales for the same period.

4. Percentage of outstanding orders (cost price) at end of current month to total purchase (cost price) during the previous calendar year. This ratio is designed to

reflect the extent to which merchants are ordering goods for the coming months and the extent to which they are holding back for more favorable prices or conditions.

In some of the Federal Reserve districts this information is obtained from all of the stores in dollar amounts, from which the agents compute the district and city percentages and ratios. In other districts some of the stores prefer to furnish the information in the form of percentages, that is to say, for instance, the percentage increase (or decrease) in net sales during the current month over net sales during the same month the previous year. When all of the stores reporting in any district give the information in dollar amounts, the preparation of composite or average figures for that district is, of course, relatively simple. Where, however, the stores prefer to furnish the data in percentage form, the problem of proper weights to be used in making composite figures by cities or for the district arises. The weights now being used for this purpose are derived from net sales for the previous calendar year.

Composite figures by cities (where sufficient stores are reporting in a city to render it impossible for any one to deduce figures for the individual store) and for the district are computed by the Federal Reserve agent as soon as all of the reports are in. These average or composite figures are immediately forwarded to contributing stores. The data for each Federal Reserve District also appear in the published report of the Federal Reserve Bank on business conditions, which comes from the press about the twenty-fifth of each month. The reports from each of the districts are assembled and published in the *Federal Reserve Bulletin* showing the state of retail trade throughout the whole country. This service is rapidly gaining the confidence and interest of large retail trade merchants throughout the country. At present about one hundred and fifty stores are reporting each month. It is thought that in the comparatively near future at least two hundred stores will be reporting regularly.

Although encouraging progress has been made, the service is yet in process of being built up. Ten or fifteen new stores are added to the reporting list each month. For this reason caution should be observed in interpreting the figures over a period of time, though, of course, comparisons are made between identical stores in any given month. It is interesting, however, to note the reflection, in the accompanying table taken from the *Federal Reserve Bulletin*, of the slowing up in retail trade—which, as is well known, has been going on for several months—the effect of reduction sales in several of the centers, and consequent upon the latter, the improvement in turnover. The figures of outstanding orders are particularly difficult to interpret at this time, due to the disturbed transportation situation. There is no doubt that in many cases, particularly a month or two ago, the outstanding orders included orders on which delivery was overdue as well as actual orders for future delivery.

It is not claimed, of course, that these figures are perfect for the purpose of reflecting the condition of retail trade. Their most serious shortcoming is the fact that they are in terms of values. This requires, of course, that the influence of fluctuating prices be eliminated by the individual's making use of the material. However, as yet no practicable method of obtaining this information in terms of

CONDITION OF RETAIL TRADE IN FEDERAL RESERVE DISTRICTS NOS. 1, 2, 3, 4, 5, 6, 7, 10, AND 12*

[Percentage of Increase]

Comparison of Net Sales with Those of Corresponding Period Previous Year

District and City	March, 1920	April, 1920	May, 1920	Jan. 1, 1920, to Close of— June, 1920	March, 1920	April, 1920	May, 1920	June, 1920
District No 1:								
Boston	38.9	16.8	19.4	27.8	30.7	26.1	24.7	25.3
Outside	29.4	26.0	25.5	28.5	36.4	33.1	30.5	30.0
District	37.5	18.5	20.7	28.0	31.6	27.5	25.8	26.2
District No 2:								
New York City and Brooklyn	66.6	15.0	41.1	26.4	59.3	35.0	35.3	32.7
Outside	50.4	22.4	22.8	32.3	38.1	33.6	30.1	31.7
District	64.8	15.8	35.4	28.4	57.0	34.9	33.7	33.8
District No. 3	37.5	12.4	50.7	34.3	26.2	20.5	30.9	31.4
District No. 4	45.5	18.4	31.3	31.5	38.2	33.6	32.1	34.6
District No. 5	23.1	3.9	11.0	21.4	12.1	8.8	9.3	11.6
District No. 6	27.4	23.4	31.0	24.3	29.9	22.0	28.1	29.3
District No. 7	65.2	33.3	49.7	59.6	57.4	43.5	49.6	58.7
District No. 10	24.6	19.6	10.9	12.9	26.9	24.9	21.2	17.9
District No. 12:								
Los Angeles	58.4	43.6	38.2	39.0	61.2	56.1	52.2	49.8
San Francisco	35.4	28.5	40.9	23.6	39.7	36.6	37.6	35.3
Oakland	31.0	14.9	17.1	15.2	32.3	27.9	25.6	23.2
Sacramento	65.1	33.9	34.4	32.1	60.9	47.5	39.4	38.3
Seattle	19.2	4.3	6.3	11.1	21.8	16.2	13.9	13.4
Spokane	19.8	10.9	48.8	62.8	26.8	23.1	29.1	35.7
Salt Lake City	10.5	7.1	26.4	18.3	15.1	12.8	16.4	14.7
District	37.8	13.8	31.2	27.8	41.0	36.9	34.7	33.2

Stocks at End of Month Compared with—

District and City	Same Month Previous Year March, 1920	April, 1920	May, 1920	June, 1920	Previous Month March, 1920	April, 1920	May, 1920	June, 1920
District No. 1:								
Boston	42.3	45.2	44.5	43.8	9.9	4.0	[1]3.4	5.6
Outside	44.9	43.2	43.8	36.3	11.9	2.8	[1]1.8	5.1
District	42.8	44.7	44.3	41.4	10.2	3.7	[1]2.9	5.5
District No. 2:								
New York City and Brooklyn	69.6	53.8	47.9	45.5	27.9	[1].3	[1]6.6	5.4
Outside	60.6	51.6	51.7	38.4	9.3	[1]1.4	[1]1.7	7.7
District	68.6	53.6	49.1	43.2	25.8	[1].4	[1]5.0	6.1
District No. 3	24.3	25.7	30.4	26.7	12.3	5.4	[1]6.7	3.0
District No. 4	56.1	63.9	57.0	53.3	11.6	7.3	[1].9	1.0
District No. 5	51.5	59.5	67.1	57.2	14.1	[1].1	2.3	9.2
District No. 6	41.1	29.9	50.2	47.2	4.7	3.0	[1].5	5.6
District No. 7	64.9	39.9	49.7	77.1	10.1	....	2.1	.0
District No. 10	38.9	43.3	40.7	39.6	7.8	3.1	[1]6.1	8.8
District No. 12:								
Los Angeles	58.3	64.9	65.0	62.9	7.8	3.7	[1].5	.4
San Francisco	62.2	60.7	54.9	58.5	6.1	2.4	[1]6.5	5.2
Oakland	35.2	34.4	29.7	33.9	6.5	[1].5	[1].6	2.6
Sacramento	61.8	29.4	34.1	....	3.7	....	[1]1.5	.1
Seattle	53.8	55.5	46.7	35.6	14.9	....	[1]6.7	8.7
Spokane	63.3	39.0	59.6	57.3	27.9	[1]40.2	[1]5.7	4.4
District	58.0	56.5	52.6	52.5	9.6	....	[1]4.7	3.0

CONDITION OF RETAIL TRADE IN FEDERAL RESERVE DISTRICTS—*Continued*

District and City	Percentage of Average Stocks at End of Each Month to Average Monthly Sales for Same Period				Percentage of Outstanding Orders at End of Month to Total Purchases During Previous Calendar Year			
	Jan. 1, 1920, to End of—							
	March, 1920	April, 1920	May, 1920	June, 1920	March, 1920	April, 1920	May, 1920	June, 1920
District No. 1:								
Boston	509.5	389.8	348.4	339.2	18.8	15.8	15.4	15.4
Outside	320.5	464.7	442.5	431.7	18.6	15.5	7.5	10.0
District	389.9	405.2	366.5	358.0	18.7	15.7	12.7	12.3
District No. 2:								
New York City and Brooklyn	384.7	403.1	392.4	379.9	18.8	17.6	15.5	16.8
Outside	372.3	392.8	415.7	349.5	20.3	21.8	13.9	17.7
District	383.4	402.0	399.4	369.9	19.0	18.2	14.8	17.2
District No. 3	380.0	347.0	382.6	357.5	24.8	23.5	17.6	19.3
District No. 4	369.1	439.0	362.8	352.3	19.4	34.8	13.2	16.2
District No. 5	423.8	422.2	421.5	407.8	16.9	12.1	9.9	9.7
District No. 6	305.8	.....	.....	.....	20.9	20.1	20.6	17.0
District No. 7	298.6	332.5	.....	328.3	31.4	31.2	31.9	19.5
District No. 10	337.6	272.1	285.4	353.7	14.6	18.0	5.4	25.3
District No. 12:								
Los Angeles	468.3	390.7	480.4	481.3	33.9	39.0	29.7	26.2
San Francisco	494.9	492.3	469.8	508.8	31.0	27.7	23.9	26.0
Oakland	610.7	585.2	589.5	573.8	....	....	....	....
Sacramento	....	....	533.4	531.3	....	....	....	....
Seattle	542.6	527.9	539.7	524.6	17.6	17.2	14.2	16.3
Spokane	605.8	528.8	605.4	579.4	34.7	....	31.1	25.1
Salt Lake City	.....	.....	.....	.....	....	....	....	....
District	515.3	456.0	508.0	516.0	27.2	21.6	23.2	23.1

[1] Decrease.

* The Federal Reserve Districts listed above are numbered as follows: District No. 1, Boston; No. 2, New York; No. 3, Philadelphia; No. 4, Cleveland; No. 5, Richmond; No. 6, Atlanta; No. 7, Chicago; No. 10, Kansas City; and No. 12, San Francisco.

physical quantities has been devised. No attempt has been made to combine figures of the various sections of the country into one set of indexes reflecting the condition of retail trade throughout the country. It is felt that such a figure would be of doubtful value, inasmuch as the condition of retail trade in the large centers may be quite different from that in the smaller cities and rural districts. It is the purpose of the Federal Reserve Board to make every effort to build up this reporting service until it includes a representative number of retail stores throughout the country.

F. W. JONES.

DEVELOPMENTS IN THE BANKING FIELD WITH SPECIAL REFERENCE TO FEDERAL RESERVE MATTERS

In accordance with the plan adopted last year of publishing a mid-summer statistical review supplementary to the more elaborate presentation in the annual report, the July number of the *Federal Reserve Bulletin* contains a series of tables showing developments in the banking situation during the past year.

The following table shows the condition of all the banks belonging to the

Federal Reserve System on June 30, November 17, and December 31, 1919, and on May 4 and June 30, 1920, these being the dates for which reports were required from all member banks during the past year:

ABSTRACT OF REPORTS OF CONDITION OF ALL MEMBER BANKS OF THE FEDERAL RESERVE SYSTEM

[In Thousands of Dollars]

	June 30, 1919 (8,822 Banks)	Nov. 17, 1919 (8,995 Banks)	Dec. 31, 1919 (9,066 Banks)	May 4, 1920, (9,291 Banks)	June 30, 1920 (9,399 Banks)
Resources					
Loans and discounts	14,890,471	16,603,963	17,032,747	17,794,164	18,076,111
Overdrafts	17,993	28,939	22,403	22,080	22,587
Customers' liability on account of letters of credit	14,789	6,116	8,706	7,482	11,015
Customers' liability on account of acceptances	440,411	539,097	624,571	655,405	652,001
United States Government securities owned[1]	4,036,899	3,660,943	3,506,426	3,081,156	2,941,655
Stock of Federal Reserve Bank	82,729	86,810	87,434	92,435	94,485
Other bonds, stocks, and securities[2]	2,947,967	3,190,272	3,224,007	3,175,951	3,124,897
Banking house	402,726	424,995	432,780	453,922	464,634
Furniture and fixtures	45,402	49,600	50,405	55,808	57,763
Other real estate owned	68,775	71,459	69,177	70,819	69,066
Lawful reserve with Federal Reserve Bank	1,723,774	1,825,152	1,903,814	1,865,638	1,838,648
Items with Federal Reserve Bank in process of collection	369,612	597,385	579,235	580,063	615,116
Due from banks, bankers, and trust companies	2,125,074	2,575,356	2,518,709	1,874,173	1,824,041
Cash in vault	559,433	602,992	691,173	620,897	621,817
Exchanges for clearing house, also checks on banks in same place	1,188,101	1,294,043	1,509,006	867,427	1,228,799
Outside checks and other cash items	109,046	134,379	147,276	102,996	126,269
Redemption fund and due from United States Treasurer	38,484	38,689	41,489	37,187	38,505
Approximate interest earned but not collected	67,362	67,530	69,354	66,070	73,728
Other assets	114,681	62,788	97,544	323,899	313,164
Total	29,243,729	31,860,508	32,616,256	31,748,572	32,194,301
Liabilities					
Capital stock paid in	1,489,792	1,565,871	1,593,753	1,695,555	1,717,014
Surplus fund	1,292,716	1,343,684	1,375,780	1,446,915	1,480,456
Undivided profits, less expenses and taxes paid	482,889	572,682	491,893	588,697	561,427
Approximate interest and discount collected but not earned	66,306	74,482	76,582	88,786	93,174
Amount reserved for taxes accrued	60,227	64,681	55,808	62,560	67,689
Amount reserved for interest accrued	24,302	40,410	24,843	39,404	26,474
Due to Federal Reserve Banks	11,876	16,435	14,189	21,547	24,682
Due to banks, bankers, and trust companies	3,650,502	4,078,615	4,091,400	3,524,359	3,461,016
Certified and cashiers' or treasurers' checks outstanding	704,349	789,035	906,515	518,517	648,361
Demand deposits	13,195,072	14,849,003	15,156,169	14,833,215	15,067,172
Time deposits	4,343,382	5,049,493	5,304,793	5,747,532	5,910,926
United States deposits	902,339	386,309	648,555	190,168	260,179
Bills payable with Federal Reserve Bank	1,368,112	1,401,373	1,190,331	1,246,721	1,122,067
Bills payable other than with Federal Reserve Bank	68,136	71,703	71,488	133,497	155,443
Cash letters of credit and travelers' checks outstanding	24,875	13,763	17,173	36,109	28,896
Acceptances	466,586	565,676	641,018	673,852	673,565
National bank notes outstanding	676,657	680,344	685,237	687,931	687,653
United States Government securities borrowed	233,638	167,228	182,665	123,143	130,860
Other bonds and securities borrowed	6,697	6,429	5,578	6,119	4,582
Other liabilities	175,276	123,292	82,486	83,945	72,665
Total	29,243,729	31,860,508	32,616,256	31,748,572	32,194,301

[1] Includes U. S. Government securities borrowed by national banks.
[2] Includes other bonds and securities borrowed by national banks.

A steady growth of loans and discounts from 14,890 millions on June 30, 1919, to 18,076 millions on June 30, 1920, is indicated, notwithstanding the fact that loans secured by government war obligations, *i. e.*, by Liberty bonds, Victory notes, and Treasury certificates, were liquidated in considerable volume during the year. Figures showing the holdings of such loans are not available for all member banks, but only for those member banks in leading cities which report weekly to the Federal Reserve Board and whose loans constitute about 80 per cent of all loans of member banks. A decrease in loans secured by government war obligations (exclusive of amounts rediscounted with Federal Reserve banks) from 1,381 millions on June 27, 1919, to 773 millions on April 30, 1920, is shown. Since then a further reduction in these holdings has taken place, the July 16 total being about 736 millions. Loans secured by stocks and bonds, and representing to a large extent loans for speculative purposes including stock exchange loans, show no material change from the high level of the summer of 1919. On August 29, 1919, the earliest available date, such loans amounted for the reporting member banks to 2,915 millions, whereas on April 30, 1920, they aggregated 3,170 millions, and on July 16, 3,046 millions. The larger part of the growth of the loan burden of the banks in the Federal Reserve System is thus attributable to the increase in ordinary commercial loans, which is due in large measure to the general spread after the war of speculation in securities, land, and commodities, and, during the more recent period, also to the increase in "frozen" credits due to difficulties and delays in transportation.

In harmony with this increase in loans and discounts, individual demand deposits of the member banks show an increase from 13,195 to 14,833 millions for the period covered by the table, and time deposits an increase from 4,343 to 5,748 millions. Government deposits, on the other hand, declined from 902 millions to 190 millions, and bank deposits ("due to banks, bankers, and trust companies") from 3,650 to 3,524 millions.

In connection with the just noted decrease in the amount of paper based on government loans, it is of interest to compare the amount of funds of all the banks in the country that are tied up in holdings of government securities and in loans based on such securities. On June 30, 1919, this amount was estimated at between 6 and 6½ billions. Judging from the amount of liquidation reported by the member banks, the amount thus tied up at present is below 5 billions, probably nearer 4½ billions. This reduction reflects the smaller floating debt of the government, *i. e.*, the smaller amount of Treasury certificates outstanding, also the steady absorption by the public during the year of Liberty bonds and Victory notes. It indicates that during the year bank funds have been gradually released from service to the government and placed at the service of commerce and industry.

During the war, the Federal Reserve Board kept its discount rates low enough to permit the member banks to carry government obligations either for themselves or for their customers who were purchasing government war securities on the partial payment plan. It was not until November, 1919, that the board felt justified in launching a policy of advancing rates. Since

that time decided advances have been made. In the early part of 1919, rates on commercial paper varied at the different banks in accordance with maturities from 4 to 5½ per cent, whereas at the present time they are 6 per cent at eight of the banks, and 7 per cent in the Boston, New York, Chicago, and Minneapolis banks. That this advance in rates has had a tendency to check the rate of credit expansion cannot be doubted. In March, 1919, the earning assets of the Reserve banks aggregated 2,348 millions and in November 2,923 millions, an increase of about 575 millions, whereas in June, 1920, they were about 3,183 millions, the increase over the November figure being about 260 millions. The growth of credit during the most recent period was thus only about one-half as great in absolute volume as the growth during the immediately preceding period of about equal length.

Although an advance in discount rates is the traditional method at the command of the Federal Reserve system with which to check credit expansion, it has been realized by the board that in many cases the principal danger was not from general expansion but from overloaning to individual banks which called upon the Federal Reserve banks for much more than their pro-rata share of loanable funds. To enable the Federal Reserve banks to exercise control over this matter, an amendment to the Federal Reserve Act was recommended by the board and passed on April 13, 1920. This amendment authorizes the Federal Reserve banks to charge rates "graduated or progressed on the basis of the amount of the advances or discount accommodations extended by the Federal Reserve Bank to the borrowing bank." Four of the Reserve banks, those at Atlanta, St. Louis, Kansas City, and Dallas, have adopted systems of progressive rates under which a member bank obtaining accommodation in excess of its basic line, which is determined differently by the various Reserve banks, must pay a rate of discount increasing progressively with the amount of the excess borrowings. The effect of the adoption of these plans has been to distribute the loans more evenly among a larger number of member banks in each of the four districts, and thus to diminish somewhat the concentration of borrowings within a small number of large banks. It may be added in this connection that general restriction and contraction of credit have never been the objects aimed at by the Federal Reserve policy. The aim has been, rather, to improve the character of credit accorded by the Federal Reserve and member banks, and in harmony with this view no uniform method is pursued by the Federal Reserve banks. It is recognized by the Federal Reserve Board that the problem of wise control of the flow and volume of credit by the Federal Reserve banks is regional in its character and accordingly the Federal Reserve banks have been allowed considerable latitude in the matter of choice of credit control.

The effect of rate advances and of progressive rates on the cost of accommodation at the Federal Reserve banks may be seen from the following table of rates of earnings from different classes of investments.

It will be noted that the average returns from all investments of the Federal Reserve banks advanced from 4.01 per cent in June, 1919, to 5.51 per cent in June, 1920.

To sum up, it may be stated that the rapid expansion of bank credit after the

RATES OF EARNINGS FROM INVESTMENTS OF THE FEDERAL RESERVE BANKS FROM JUNE, 1919, TO MAY, 1920

Date	Bills Discounted	Bills Bought in Open Market	United States Securities	Total Investments
1919	*Per cent*	*Per cent*	*Per cent*	*Per cent*
June	4.20	4.19	2.33	4.01
July	4.15	4.27	2.24	3.98
August	4.13	4.22	2.21	3.93
September	4.17	4.27	2.17	3.91
October	4.15	4.22	2.18	3.95
November	4.40	4.33	2.22	4.16
December	4.55	4.54	2.19	4.29
1920				
January	4.71	4.79	2.18	4.46
February	5.20	5.06	2.18	4.88
March	5.49	5.47	2.10	5.12
April	5.58	5.70	2.10	5.23
May	5.66	5.77	2.22	5.36
June	5.89	5.98	2.24	5.51

war, when the need of assisting the government by low discount rates became less urgent, induced the Federal Reserve Board and the Reserve banks to advance discount rates and to take measures toward the wider diffusion of borrowings through the adoption of progressive rates. The results of this policy are seen in a definite slowing down of credit expansion, a decided liquidation of loans contracted for speculative and non-essential purposes, and a somewhat lessened concentration of credits at Federal Reserve banks within a relatively small group of member banks.

M. JACOBSON and E. A. GOLDENWEISER.

LIFE TABLES FOR THE CITY OF HAVANA*

A set of life tables for the city of Havana has just appeared in the official sanitary bulletin of the Republic of Cuba. These tables were prepared by Dr. Vega Lamar, chief of the Bureau of Records and Correspondence. They are the first tables not only for Cuba but for any of the Latin-American countries. They are, therefore, of special interest to American demographers and all the more so because they appear to have been well done after the method outlined by King in his supplement on life tables prepared for the seventy-fifth annual report of the registrar general of England and Wales.

There are six tables in all; the first two are for whites, males and females, respectively; the second two for negroes of both sexes; and the third two for mulattoes. The last are more accurately called "mestizos," that is, half breeds. But, as the Indian element is negligible in the present population of Havana, this term is equivalent to a mixture of whites and negroes, for which the word mulatto is the most accurate translation. The period covered is the decennium between 1904 and 1914, the population data being based on the two censuses of 1900 and 1907.

At age zero, the curtate expectation of life of white males and females in

* Sanidad y Beneficencia, Boletin Oficial de la Secretaria, *vol.* XXII, Nos. 1, 2, and 3, July, August, September, 1919, pp. 59–74. Ministry of Health and Charities, Habana.

Havana was 42.0 and 46.2 years, respectively. These figures are approximately five years lower than for white males and white females in cities of the original registration states of the United States in 1910. The differences lessen somewhat with advancing age, especially in the case of females. At age twenty, the difference is about four years for males and about three and one-half years for females. At age forty, white males in Havana have an expectation of only twenty-one years, which is nearly four years less than that for white males in American cities. White females show a difference only of one and one-half years. At age fifty, there is still a difference of three years between the white males of the two areas, but the difference for females is only one-half year. The death rate for white males at this age is two-thirds higher in Havana than in American cities. At age sixty, Cuban white males are still two years behind in expectation, whereas the white females of Havana have caught up with the American figures. The striking fact of this table is the marked superiority in the longevity of white females over white males in the city of Havana.

The tables for the negroes of Havana are very instructive, although they are not quite comparable with those for the negroes of the original registration states because the latter include the mulattoes which form so large a part of our colored population. At birth, the curtate expectation of life of a negro male in Havana is 34.8 years as compared with 33.6 in our registration states; of a negro female, 38.9 years in Havana and 37.2 years in the United States. At the earliest ages, there seems to be a somewhat better expectation for the negroes of Cuba than for those of the registration states. But this advantage is soon lost; for at age five, the expectation of negro males in Havana is 40.5 years as compared with 43.8 for negro males in the United States, and 42.4 for negro females in Havana as compared with 45.9 for negro females in the United States. The more favorable situation of negroes at age zero in Havana may be due to the lower infant and early childhood mortality rates in that city than among negroes in American cities; but the element of poor death certification of negro infants may also be a factor. After age five, the death rates for Havana negroes are uniformly higher than for American negroes at the corresponding age periods, and the expectation of life is lower.

The figures for mulattoes are very surprising. At birth, the curtate expectation of life for males is 38.1, or four years less than for white males and three and one-quarter years more than for negro males. Female mulattoes show an expectation of 39.8 years, which is six and one-third years less than for white females and one year more than for negro females. The actual death rates during the first few years of life are high for both sexes of the mulattoes. But these decline rapidly and by age three the rates for both sexes are lower than for negroes; by age five they are lower than for white males, and at age forty-five than for white females. We, therefore, find the anomalous condition of a higher expectation of life for mulatto males and females than for white males and females after certain ages. What it is that accounts for the apparently superior longevity for persons of colored blood is not indicated in the report. It will be well worth while for the sanitary authorities of Cuba to analyze the details of mortality by causes of death in order to determine just what the explanation may be. Cer-

tain irregularities in the figures for female mulattoes at the ages after forty-five suggest that the table may be defective at these points.

The tables altogether confirm what has been known with regard to health conditions in Cuba under the present administration. Much excellent work is being accomplished, but much remains to be done. It should not be a difficult matter for the people of Havana to show even better conditions of the death rate and of the expectation of life in the next table—say ten years hence. The most promising results will follow from an attack on the problems of infant mortality and of tuberculosis. Cubans are, obviously, a hardy people, living under very favorable conditions of nature. The old dangers to life in the tropics no longer menace them. Plague, yellow fever, cholera, and the other scourges are matters of the past. As with us in the United States, the health program of the future will consist in developing more intensive work along the lines of personal hygiene under public direction. The Cuban administration of the public health may be expected to make good its efforts along such lines, as it has done in the control of the tropical diseases.

LOUIS I. DUBLIN.

INTERNATIONAL STATISTICAL ORGANIZATION UNDER THE LEAGUE OF NATIONS

Under Article 24, Part I, of the Peace Treaty, all international bureaus and commissions for the regulation of matters of international interest are to be placed under the direction of the League of Nations. If the parties concerned agree, this may also be done with similar international bodies which are already in existence. In August, 1919, the application of this section to the organization of statistics was the subject of a conference held in London under the direction of the Economic and Finance section of the League. This conference was composed of representatives of the Institute of Agriculture at Rome and the International Institute at the Hague, and leading statisticians, their object being to discuss the relations of the League with these bodies, and also in general the way in which the new League organization could profitably assist the development of international coöperation in statistics.

It was the unanimous opinion of this conference that it would be of great advantage if all the work in the statistical field whose accomplishment is a necessity in the political life of nations could be organized under a centralized system. The plan suggested was that of a central advisory council to meet normally at the seat of the League. With regard to the main classes of statistics, namely, (a) commercial, industrial, and economic, (b) agricultural, (c) labor, and (d) demographic, it was the opinion that these should be entrusted to different bodies under the League, the existing bodies being designated as the International Institute of Agriculture at Rome (agriculture), the International Labour Office (labor), and the Permanent Bureau of the International Institute at the Hague (demography).

The conference of August, 1919, was purely informal, the members being without mandates from their respective governing bodies, and it disbanded with a

recommendation for the appointment of a committee for the purpose of drawing up more definite recommendations, and with a general instruction to the Secretary General of the League to obtain, in as representative a manner as possible, further views from international statisticians upon the questions considered. In accordance with the latter instruction, a conference took place in February, 1920, between the British Empire Statistical Conference, then meeting in London, and the Secretary General.

The matter as a whole, in the light of these and other representations, was reconsidered at the meeting of the Council of the League which took place in Rome in May, 1920. It was decided in effect to open the question *ab initio* and formally, by the appointment of a commission. The report on the question, which was presented by the Belgian representative, M. Destrée, after recounting the action already taken, pointed out that any attempt to realize the desirable object of uniformity and centralization in statistics raises problems which cannot be solved without the help of experts, "both statisticians and persons who make use of statistics." The report presented by M. Destrée and adopted by the Council proceeds:

"I propose that, to this end, a commission be set up on the following lines: Each of the existing bodies, *viz.*:

International Labour Office,
International Institute of Statistics,
International Institute of Agriculture,
International Bureau of Commercial Statistics (Brussels),

should be invited to nominate one representative. This committee should be completed by the addition of the following persons, whose work in the past points beyond question to such a choice:

M. Lucien March, M. de Elola,
Mr. R. H. Coats, M. Luigi Bodio.

The commission thus formed should have power to add to its number by coöperating with other eminent statisticians whose collaboration it might desire. At the same time, it should use every effort to keep its numbers as low as possible."

It is understood that the commission thus appointed will assemble for a session of three or four weeks during September, 1920.

R. H. C.

MISCELLANEOUS NOTES

The progress of the Fourteenth Census work to July 1, 1920, is indicated in the following note. Up to July 31 the Bureau of the Census had announced the population of 4,629 cities, towns, and villages, and of 1,039 counties, having an aggregate population of 65,818,354. The latest comparative figures which have been prepared, showing the increase between 1910 and 1920 as against the increase for the same places between 1900 and 1910, relate to those places for which the populations had been announced on or before July 31. At that time the increase between 1910 and 1920 for the 4,157 cities, towns, and villages, and the 1,003 counties for which comparative figures for the last

three censuses are available amounted to 10,118,718, or 18.5 per cent. For the same places the increase between 1900 and 1910 was 10,505,037, or 23.7 per cent. So far as can be judged from the figures thus far compiled, the decline in the rate of increase in population between 1910 and 1920, as compared with the rates for the decades 1890–1900 and 1900–1910, will be just about what might have been expected in view of the drop in immigration and the excessive mortality due to the war and the influenza epidemic. The Fourteenth Census of the United States was taken as of date January 1. The progress of the enumeration was materially impeded by the unusually severe weather conditions which prevailed in most of the northern states. Even in the south the enumeration was delayed by the torrential rains which occurred in many localities. As a result of these adverse conditions, the returns from the enumeration were not received at the Census Office as rapidly as had been hoped and expected. Nevertheless, they have come in promptly enough to enable the Bureau to get its tabulating force organized and at work about as soon as had been expected. The progress the Bureau is making on the work is gratifying, and justifies the prediction that the data will be compiled, published, and issued by June 30, 1922, as provided by law.

The statistical work which the United States Railroad Labor Board used in making its recent decision regarding wage rates was under the supervision of Professor Horace Secrist, of Northwestern University. As supervising statistician, Professor Secrist, though continuing his connection with the university, will coordinate the statistical activities of the Board and act in an advisory capacity on matters of statistical interpretation and presentation in the decisions, reports, and findings of the Board.

The government of France has sent out invitations to all foreign governments, inviting them to send representatives to a Conference for the Revision of the International List of Causes of Death. The Conference is to meet in Paris on October 11, 1920. Six countries have already accepted the invitation according to last accounts. The participation of the United States is under consideration by the federal government. It is hoped that a group of representative statisticians will be sent and that the personnel of the American commission will include, among others, those who have busied themselves during the last few years with the problems of classifying the causes of sickness and death, with special reference to the revision of the list in the forthcoming Conference in Paris.

The Amalgamated Clothing Workers have formed an organization for the collection of statistical material on a comprehensive scale. This work was begun in February, 1920, in preparation of evidence for the Rochester injunction suit. Under the direction of Dr. Leo Wolman of the New School for Social Research a survey was made of the effects of trade unionism on the industry. The results of this survey which should be of interest to statisticians are contained in an accumulation of statistical data relating to the course of wages in the industry from 1911 to December, 1919. The survey did not restrict itself to

the study of general wage movements, but examined also such causal factors as the wages of male and female workers, piece and time workers, the variation of wages in the four major markets, the relation between the growth of organization and wage changes, and the concurrence of wage movements in the men's clothing industry with those in other industries. It is hoped that within the next year this and similar material will be made available for more general use. It is a hopeful sign of progress that the interest of the Amalgamated Clothing Workers in statistical information did not cease with the completion of a single survey. By the authority of the General Executive Board of the Organization, a permanent research bureau, organized to collect and interpret statistical material, was established early in July. Dr. Wolman has been appointed director of the bureau, and Mr. H. K. Herwitz, formerly with the United States Shipping Board and the United States Tariff Commission, is directly in charge of the bureau at the national headquarters of the union in New York City.

The Northwestern University School of Commerce is undertaking for the National Association of Retail Clothiers a clothing survey national in its scope. This survey extends to the complete membership of the Association and deals with the merchandising practices of retailers of clothing and the retail costs of distributing clothing. A preliminary report will be made on the results of the survey at the annual meeting of the National Association of Retail Clothiers which will be held in Chicago in September. A complete report will be published later by the Bureau of Business Research of the Northwestern University School of Commerce.

Dr. Frederick R. Macaulay and Dr. Wilford I. King have been appointed statisticians for the National Bureau of Economic Research, Inc. Dr. Macaulay leaves the Department of Economics of the University of California and Dr. King was public health statistician in the United States Public Health Service. Dr. King will still act as consultant for the Public Health Service.

Dr. R. B. Robbins, whose special field is mathematical statistics and actuarial theory at the University of Michigan, is on temporary leave of absence and will take up work as assistant actuary in the Department of Insurance in Missouri.

Dr. Royal Meeker has resigned his position as United States Commissioner of Labor Statistics and has sailed for Geneva, Switzerland, to take charge of the scientific section of the International Labor Office under the League of Nations. Mr. Ethelbert Stewart has been appointed as Commissioner of Labor Statistics, his appointment having become effective August 1.

The International Commission appointed for the purpose of advising the League of Nations as to the statistical organization and policy to be adopted, will hold its first meeting in September, probably at Brussels. The commission at present consists of one representative each from the International Labor Office, the International Institute of Statistics, the International Institute of

Agriculture, and the International Bureau of Commercial Statistics (Brussels), and of the following persons: M. Lucien March, Director of the General Statistical Office of France, Mr. R. H. Coats, Chief of the Dominion Bureau of Statistics of Canada, M. Luigi Bodio, President du Conseil Superieur de Statistique at Rome, and M. de Elola. Mr. Coats sailed from Canada in August to be gone probably for several months.

The Bureau of Applied Economics, Inc., Washington, D. C. has presented through Mr. W. Jett Lauck statistical briefs for organized labor in the recent hearings before the United States Coal Commission, before the United States Anthracite Coal Commission, and before the United States Railroad Labor Board. These statistical briefs have been separately published and consist chiefly of data on wages, profits, and cost of living.

An interesting and significant instance of the use of statistics is the work done for the Republican party on platform and policies. Early in 1920, the National Committee appointed an Advisory Committee on Policies and Platform whose function in part consisted in gathering facts and data to serve as a basis for the decisions of the Committee on Resolutions and of the convention. The work of this committee was in charge of a staff of some fifteen specialists largely from university faculties and selected for their expert knowledge in the various fields of public policy, concerning which there were to be planks in the party platform. The director of the staff was Dr. Samuel McCune Lindsay of Columbia University and the associate director was Dr. Jacob H. Hollander of Johns Hopkins University. Of especial significance is the decision to continue this work which was made by the National Convention in adopting unanimously a resolution authorizing the continuance and regularization of such investigations for the next convention.

NEW MEMBERS ELECTED SINCE MAY 1

Corporate Membership

National City Bank, 55 Wall St., New York City.

Regular Membership

Arrus, Oscar F., Lawyer, Formerly Chief of Statistical Section of Custom House, Calle Constitucion No. 20, Callao, Peru, South America.

Bernhardt, Joshua, U. S. Sugar Equalization Board, Inc., 111 Wall St., New York City. Chief statistician.

Biele, Edward, Norwich Pharmacal Co., Norwich, N. Y. Comptroller of the Company.

Bloom, Louis, 12 East 14th St., New York City. Accounting. Statistical work relating to clothing industry.

Brasher, Philip, Tidewater Oil Co., 11 Broadway, New York City. Industrial engineer, interested in management control statistics.

Brown, Helen E., Travelers Ins. Co., Hartford, Conn. Member of Actuarial Department.

Burke, William J., 18 Broadway, New York City. New York Transit Co., Standard Oil Subsidiary.

Cassmore, Melvin W., Bon Marche, Seattle, Washington. General research. Department store.

Chase, Charles H., 445 Quincy St., N. W., Washington, D. C. Economic Research, Council of National Defense.

Chen, Ta, 522 West 123d St., New York City. Student at Columbia University.

Clark, Mary A., American Social Hygiene Ass'n. New York City. Library research.

Coyle, Eunice S. Wadsworth House, Cambridge, Mass. Committee on Economic Research, Harvard University.

Crawford, N. Russell, Industrial Works, Bay City, Mich. Compiling and charting executive reports.

Crosby, Francis D., 55 Seaview Ave., East Norwalk, Conn. Student at New York University.

Croxton, Frederick E., Ohio State University, Columbus, Ohio. Laboratory assistant and research work.

Devereux, F. L., 118 South 19th St., Omaha, Neb. General Auditor, The Northwestern Group, Bell Telephone System.

Gini, Alfred S., Pathé Exchange, Inc., 25 West 45th St., New York City. Motion picture accounting. Auditor.

Groth, Herman A., 104 South Michigan Ave., Chicago, Ill. Treasurer of the Wm. H. Rankin Co., Advertising Agency.

Hahne, Ernest H., Northwestern University, Chicago, Ill. Teaching.

Hall, Lawrence L., 5 Wendell St., Providence, R. I. Manufacturing Dept., U. S. Rubber Co., New York City.

Henne, Edwin W., 715 Locust St., Des Moines, Iowa. Statistician and Actuary, Iowa Bonding & Casualty Co.

Holt, Dr. William Leland, University of California, Southern Branch, Los Angeles. Teaching.

Jeter, Helen R., 2559 Michigan Ave., Chicago, Ill. Research assistant, University of Chicago.

Johnson, George W., Western Electric Co., Inc., Chicago, Ill. Telephone manufacture.

Johnson, Verner A., 5 Magnolia Square, Dorchester, Mass. Charting trend, etc., firm for converting cotton goods.

Johnston, Paul I. Pierce Oil Corporation, 25 Broad St., New York City. Charge of General Statistical Department.

Keuper, Charles F., 4712 Drexel Blvd., Chicago, Ill. Division Sales Manager of Ford Roofing Products Co. of St. Louis, Mo.

Kilborn, Robert C., Interchurch World Movement, 45 West 18th St., New York City. Director surveys, statistical department.

Kollman, Sara E., 80 Schermerhorn St., Brooklyn, N. Y. Visiting Nurse Association, Brooklyn.

Knauth, Oswald W., 175 Ninth Ave., New York City. Secretary, National Bureau of Economic Research.

Lambert, Joseph, 601 Stone Ave., Brooklyn, N. Y. Business statistics, retail linen store.

Lemmon, Allen H., Gulf Refining Co., Pittsburgh, Pa. Charge of graphic chart department.

Lewis, Cleona, University of Chicago, Chicago, Ill. Assistant in the School of Commerce and Administration.

Lowell, Ernest W., 145 Main St., South Manchester, Conn. Organization and Management of The J. W. Hale Company, Department Store.

MacKenzie, T. Findlay, 408 West 115th St., New York City.

Merwin, Margaret S., 5493 Cornell Ave., Chicago, Ill.

Metcalf, Donald J., Pi Kappa Alpha House, University Heights, New York City. Student at New York University.

Norris, Olen C., Goodyear Tire & Rubber Co., Akron, Ohio. Sales research.

Percy, Atlee Lane, 525 Boyleston St., Boston, Mass. Teaching and practice of accounting.

Pomeroy, Edwina R., 30 Washington Place, New York City. Manager of the Cost and Statistical Dept., Celluloid Co.

Reilly, Irma M., Consolidated Steel Corp., 141 Broadway, New York City. Research and trade statistics.

Rosenbluh, Charles M., 27 Cedar St., New York City. Financial statistician and accountant.

Routsong, R. C., 4501 Kansas Ave., N. W., Washington, D. C. Bureau of War Risk Insurance, Treasury Dept.

Scott, Wm. Sebert, 28 Nassau St., New York City. Manager of Statistical Department, Wm. A. Read & Co.

Siberling, Norman J., temporarily with Brown Shipley & Co., London, England. Sheldon Traveling Fellow of Harvard University.

Snodgrass, Katharine, 37 Liberty St., New York City. Division of Analysis and Research, Federal Reserve Board.

Snyder, Carl, 15 Nassau St., New York City. Manager of Statistical Department, Federal Reserve Bank.

Spasoff, Ida M., U. S. Dept. of Agriculture, Washington, D. C. Statistical work in farm financial relations.

Stern, Donald M., 341 W. 113th St., New York City, Special industrial writing for Standard Statistics Co.

Stewart, E. H., Foreign Dept., Bank of Montreal, Montreal, Canada. Development of Statistical Branch in the Department.

Tilton, Earle B., Holman & Co., 217 Broadway, New York City. Fiscal agents and investment bankers. Sales statistics.

Williamson, K. M., 40 Conant Hall, Cambridge, Mass. Teaching.

Wolman, Abel, 16 W. Saratoga St., Baltimore, Md. Sanitary engineering. Interpretation of data for sanitary and public health work.

REVIEWS

The Nation's Food: A Statistical Study of a Physiological and Social Problem. By Raymond Pearl, Ph.D., Sc.D., LL.D. Philadelphia and London, W. B. Saunders Company, 1920. Pp. 274.

Dr. Pearl's study of the nation's food problem "makes available for the first time a knowledge, to at least the first degree of approximation, of how much and what kinds of food the American people as a whole eat." It is a work that is extremely interesting to the student of statistical technique, and of national nutrition and dietary in connection with national food production and foreign trade. The occasion for the construction of this work was the participation of this country in the World War from the beginning, April 6, 1917, to the armistice of November 11, 1918, and the supply of food for some time thereafter to Allies and other peoples. Dr. Pearl was chief of the Statistical Division of the United States Food Administration.

In this work, materials are classified as (a) primary human foods, including plant materials, "and all animals or animal products in which the animal gets its nourishment from some source other than the primary feeds and fodders," and the primary feeds and fodders are plant materials used for the nourishment of domestic animals; and (b) secondary human foods, which include "all edible products of animals used for human food, the animals being nourished with primary feeds and fodders." The object of this classification is "to allocate the nutrient resources of the nation according to the usage made of them," and to avoid duplication.

Under each food classification as primary or secondary, the plan is to determine for each year from 1911 to 1917 (beginning July 1) the amount of the basic nutrients—protein, fat, and carbohydrate—produced, imported, and exported in the case of each item of food. Many of these items presented problems of great difficulty. Production may not have been estimated by another office of the government, as in the case of corn meal for instance, so that Dr. Pearl's division had to contrive its own procedure for estimating. Next, it was necessary to determine the quantity of each item of product used for human food. The entire potato crop, for illustration, is not so used; about 8½ per cent is used for seed, and as Dr. Pearl estimates seed and waste to be one-third, the estimated waste must be one-quarter.

The food product from which the three human nutrients of protein, fat, and carbohydrate may be derived is now multiplied by the appropriate factor to compute the production of the nutrients. These factors were chiefly those of Atwater and Bryant, but supplemental use was made of the factors of other investigators. As published, the gross nutrient source product, and the three nutrients derived from it, are expressed in metric tons; but when the three nutrients are combined, their common denominator is calories.

Step by step, the operations lead to consumption, by means of the familiar formula: production + (imports − foreign exports) − domestic exports. Trade

between contiguous United States and Alaska, Hawaii, and Porto Rico is "domestic," and is not included in the foreign trade statistics of this country, so that it is often necessary to add it to the foreign trade to arrive at results applicable to contiguous United States alone. This has been done in this study for Hawaii and Porto Rico and for shipments of fish from Alaska. The procedure is stated with particularity, but no mention is made of the subtraction of the foreign trade of the customs districts of Hawaii and Porto Rico from the foreign trade of the United States. The omission of this step, although it was technically required, is of no perceptible consequence.

From the foregoing description one should not form the impression that this study is mostly a matter of statistical mechanics. The fact is quite the reverse. Deductions from the gross product were often puzzling and made without tangible factors. In the case of a crop, for instance, these possible items of deduction had to be considered: (a) seed for next crop; (b) "loss from failure to harvest, and incomplete harvesting, frost damage, and other factors, lowering, in the field, the total net production"; (c) nutritional loss from plant diseases and weather injury which do not affect the quantity harvested; (d) loss from vermin (rats, etc.) and other causes in storage and transportation, including decay and spoilage of perishables; (e) manufacturing losses; (f) diversion to industrial, non-food uses. "Having made the best estimates possible of such general deductions, Atwater and Bryant's nutritive factors are applied to the residue remaining." These factors involve allowance for refuse in preparing food "as purchased" for eating.

The author is now prepared to "calculate with accuracy the total national food bill." As calculated for the six years 1911–12 to 1916–17, the average yearly consumption of protein in the United States was 3,654,572 metric tons, of fat 5,115,279 tons, and of carbohydrate 16,413,087 tons, and the total calories of these three nutrients is 129,931,314,000.

At this point an obvious difficulty arises. A statistical process may seem correct in the abstract, and yet fail to function satisfactorily. The reader, having followed the author's difficult path to this point, encounters an average that is comparable with one of similar character that has previously been established in nutritional laboratory work, namely, the nutritional requirements of the adult man per day. The work in hand does not give the reader the nutritional laboratory averages. Its own average for the seven years 1911–12 to 1917–18 is 4,288 calories, the entire population having been reduced to the equivalent number of persons of this standard unit; but this average is so absurdly high that the need of a reduction factor is evident. "In calculating the nutrients in earlier chapters, use has been made of factors which allowed for inedible refuse, so that all of the inedible portions of the foods as produced or imported have already been deducted in the calculations up to this point. However, it is obvious that there is still a considerable amount of loss or wastage of strictly edible material, which might be saved and consumed under a theoretically ideal system of preparing food for the table plus a conscientious ingestion of every bit of edible material. There is a considerable loss of nutrient values in the process of cooking as ordinarily practiced. . . . Another important

factor is that of edible waste in garbage. . . . The figures here presented are really statements of consumption plus edible waste and should be so regarded."

The computed average "consumption" of protein per day per adult man for the six years 1911–12 to 1916–17 is 121 grams; of fat, 169 grams; of carbohydrate, 542 grams; of the three nutrients, 4,290 calories.

Without giving any facts with regard to percentages of reduction to be applied to his computed numbers of consumption to eliminate this edible waste, the author states that "it seems probable that of the protein in human foods left in the country for consumption, in the statistical sense, it seems safe to say that 5 per cent is lost in edible wastage; of the fat, . . . at least 25 per cent . . . ; of the carbohydrates, probably 20 per cent." After these reductions are made, the average eaten food per adult man per day becomes 114 grams for protein, 127 grams for fat, 433 grams for carbohydrate, and for the three, 3,424 calories. The fat average is regarded as still too high. The author is reconciled to the inclusion of this waste in totals, averages, and ratios by the reflection that, after all, the population actually "uses up" the indicated amounts of nutrients. This is shifting the point of view from that of physiological nutritional requirements, which has apparently been the purpose of the study, to that of a production that must be large enough to secure them for eating. The author's concession is sensible, since the study has been unable to establish the population's requirements of eaten nutrients. But the logic of the concession cannot stop here. If practically this waste must be suffered, so must consumption by rats, spoilage by weather, the retention of seed for the next crop, and perhaps the consumption by domestic animals.

Every one who has worked at production statistics knows how difficult of establishment Dr. Pearl must have found many items, especially in times of hurry. Estimates which seem acceptable in the present may be weakened as they recede into the past. This to some extent is true of the work in hand. Production estimates for 1917 taken from the *Monthly Crop Reporter* for December, 1917, were subsequently revised. The Food Administration's estimate of the wheat crop of 1917 was used. There is apparent disagreement of considerable degree between some items of fat and oil production in this work and the figures of *Bulletin* 769 of the Department of Agriculture, one of whose authors was chief of the Fats and Oils Division of the Food Administration. Some crops are reduced by a precise fraction on account of waste, or seed and waste, and the application of this fraction to the remainder should produce a number in agreement with the crop estimate that should be used; but, as far as tested, agreement has not been found, although the difference is usually small.

An error of some moment is found in the adopted estimates of meat production made by the Food Administration. If these estimates ever were accepted by meat statisticians outside of that office, they are not accepted now. The estimate of dressed weight of meat production for 1914–15 to 1916–17 is about 10 per cent too high, and for 1917–18 about 2 per cent too high. If the subject of edible offal had been treated, as was possible, by including the fat for making the oil that was used in making oleomargarine, and the exported oleo oil, those

two food items need not have appeared in tables of secondary food production. The percentage that the edible offal is of dressed weight, already published in *Bulletin* 55 of the Bureau of Crop Estimates, should have been used, or some modification of it. For the use of that bulletin, one of the large slaughtering companies of Chicago weighed the separate edible-offal parts of over 10,000 meat animals.

This book was published in 1920 and it is regrettable that the imperfection of the hurried war work could not have been corrected in the meantime. This, however, would not have cured the greatest fundamental defect, and that is the liberty given to the statistician to create facts out of his mind. This he has constantly done in reducing production to human food production and in eliminating waste, not only from production but from the kitchen and the table.

Lest failure to mention may imply acceptance by default, objection should be made to the author's statement concerning the per capita food production. The ratio between food production and population is not the ultimate one, but it is food production per acre per capita. This comparison by no means sustains Dr. Pearl's rejoicing based on increased mere per capita production.

All are proud to acclaim the Food Administration and to regard it as one of the great successes of the war outside of army and navy operations. Yet encomiums may be misplaced, as to some small extent they are in this book. It seems not to be known that, notwithstanding meatless days and constant urgings to reduce meat consumption, the per capita consumption of meat in this country in the second year of the war (calendar, 1918) was higher than it had been for nearly a decade. But the Food Administration did not cause the orgy of meat consumption, any more than it caused the orgy of the buying of silks and shoes at $16 a pair. In wheat consumption, also, the per capita ratio kept up remarkably, in view of the restrictions and injunctions that wheat should be saved for the Allies. By dint of self denial on the part of some classes of citizens, the people as a whole managed to save per capita per week in 1917–18 less than one loaf of bread for Western Europe, but these citizens could not prevent an increased per capita consumption in 1918–19 over that of the preceding year.

A reviewer's bark may be worse than his bite, and certainly there is no biting to be done in this case. It is one of the saving graces of statistics that totals may be wrong, perhaps very wrong, and yet permit percentages and averages that are indicative of the approximate truth. It may well be the fact, as this book discovers, that, of the total energy value of the foods produced in the United States, the grains contribute 42 per cent, the meats 24½ per cent, the dairy products about 15 per cent, vegetables only 5 per cent, sugars less than 5 per cent, oils and nuts less than 5 per cent, poultry and eggs hardly 2 per cent, fruits less than 2 per cent, and fish about ⅛ of 1 per cent. This book abounds in opportunities for such interesting and important comparisons as this one, and the author has developed them with many illuminating results.

GEORGE K. HOLMES.

Washington, D. C.

Direct and Indirect Costs of the Great World War. By Ernest L. Bogart, Professor of Economics, University of Illinois. Carnegie Endowment for International Peace, Preliminary Economic Studies of the War, No. 24. New York, Oxford University Press, 1919. Pp. ix, 338.

The direct costs of war are the actual expenditures made by the belligerent nations in the conduct of the war. The author's task was to determine the cost for all the nations engaged in the World War. He has in fact done much more than this. Besides a statement of war expenditures, the book gives an account of the financial operations of the war—taxation, borrowing, banking, etc. This account is clear, detailed, and fairly complete for the leading nations, such as the United States, Great Britain, France, and Germany. In some of the other cases the record is brief and rather fragmentary. For this account students of war finance will welcome the book. It presents in clear and convenient form the facts of the subject which were obtainable during and immediately after the war. The author has not waited for all the original and official materials, nor has he undertaken to go far in analyzing the facts and drawing conclusions; but he has vastly lightened the task of any one who may wish to probe deeper into the economics of modern war finance, and he has put before us promptly the important facts as to the cost of the war and how it was met.

The net cost of the war to all the active belligerents appears to have been in the neighborhood of 186 billion dollars. The author mentions, but takes no further account of, the fact that the world's monetary units have all depreciated, and at different rates, during the struggle. As a matter of fact, the costs in different years and in different countries are measured by a changing unit. The dollar of 1918 is not the same as the dollar of 1914; and if the mark was worth twenty-five cents in 1914, it was not worth that in 1918. There is a certain mathematical fallacy in assuming to reduce to a common unit and combining in a single total quantities so diverse. However, the correction would have involved great difficulties, the margin of error would have been large, and the result would probably, for practical purposes, have been no more useful. Obviously, only the broadest and most general conclusions are intended to be drawn from such an aggregate as this.

Among the "indirect costs" of the war are included loss of human life, loss of property, loss of merchant shipping, war relief contributions, and the cost to neutral nations. This part of the book is less satisfactory than that which deals with direct costs. It is scarcely more than a hasty collection of various estimates and conjectures, without criticism or analysis. This is really all the author claims for it in his preface, when he characterizes the estimate of the indirect costs of the war as "merely the best guess which is possible at the present time." In particular, the attempt to reduce all the indirect costs to a total expressed in dollars (the figure is 152 billions) seems hardly worth the effort. Nevertheless, this part of the book is interesting and impressive, and it adds much to the cumulative picture of the gigantic, the unbelievable costs of modern warfare. This was the real object of the book, and the reader, though he peruse only the last three chapters, cannot fail to get the conclusion and be profoundly impressed thereby.

Yale University. FRED ROGERS FAIRCHILD.

American-Canadian Mortality Investigation, based on the experience of the United States and Canada during the years 1900 to 1915 inclusive, on policies issued from 1843 to 1914 inclusive. New York, The Actuarial Society of America, Volume I, 1918. Pp. 378. Volume II, 1919. Pp. 139.

The principal object of this investigation is perhaps best indicated by a brief résumé of its history. In August, 1911, a committee of the National Convention of Insurance Commissioners, in a report submitted to that body, suggested that the Actuarial Society should "turn its attention to the construction of new mortality tables covering the general experience of the companies among normal lives." The Actuarial Society of America was at that time still engaged on the Medico-Actuarial Mortality investigation and could not take up any other work until that investigation had been finished. In October, 1914, the Convention of Insurance Commissioners again renewed its request, and the next year the Actuarial Society, having in the meantime completed the other investigation, appointed a committee and authorized it to proceed with the desired investigation. Although the principal object of the investigation was the construction of the mortality table representing the experience on American insured lives, the opportunity was taken at the same time to construct a similar table for men resident in Canada at date of application. In order, also, that the experience included in each table should be homogeneous, the principal table was confined to the experience on American men. However, the experience on American and Canadian insured women was separately investigated and compared with the primary tables.

At this same time, also, the opportunity was taken to investigate the mortality experience on men by groups of states in the United States, and by groups of provinces in Canada, the experience on men analyzed by plans of insurance, on insurance changed or converted from term policies, or renewed under renewable term policies, and on insurance by amounts; and also to make an investigation of causes of death.

In the introduction to Volume I is given a complete description of the rules applied to insure homogeneity and of the methods adopted in carrying out this investigation, including the mechanical tabulation of the cards and the graduation of the resulting data. The following summary will give an idea of the extent of the data in the various sections of the experience:

	Deaths	Total Exposures	Ratio of Exposures to New Entrants
American men	$436,345,200	$26,003,321,900	11.64
Canadian men	29,400,800	2,743,665,100	8.08
American women	10,878,500	787,819,500	8.58
Canadian women	672,500	69,144,100	8.35

The predictions which had been made with regard to the probable result of the investigation were in the main confirmed, the rates of mortality in the ultimate part on the table based on the experience on American men agreeing substantially with those in the M. A. table. The following schedule shows the rates

of mortality at specimen ages and also the ratios of those rates to the corresponding rates given in the American experience table, in the United States life table for white males, and in the 0^{m} [5] table:

Age	Rate of Mortality	Ratio to American Exp.	Ratio to U. S. Males (White)	Ratio to 0^{m} [5]
25	.00431	.53	.78	.63
35	.00478	.53	.56	.58
45	.00794	.71	.63	.67
55	.01747	.94	.81	.84
65	.04066	1.01	.93	.96
75	.09194	.97	.99	.99
85	.19707	.84	1.03	.96

The rates of mortality in the graduated table are shown in select form, the select rates running into the ultimate at the end of five years. This procedure is justified by the figures contained in the following schedule:

Insurance Year	Ratio of Actual to Expected—Per cent
1st	63.4
2nd	84.1
3rd	87.4
4th	89.6
5th	91.5
6th	98.6
7th	101.2
8th	97.7
9th	104.4
10th	96.4
11th and subsequent	100.0

A comparison is given of the net premium rates and reserves according to the new table with those according to the American experience table, and indicates that for some plans and ages the new basis would show a lower reserve than the old, whereas on others it would show a higher. The statement is made that a valuation of one of the largest and oldest life insurance companies showed an aggregate reserve on the basis of the new table of 2 per cent greater than that on the American experience table, both at 3 per cent interest.

An interesting feature in connection with the graduation of both the American men table and the Canadian men table is that Makeham's second modification of Gompertz' formula was adopted, it having been found impossible to fit satisfactorily Makeham's first modification to the data. The graduated rates of mortality on Canadian men are higher than on American men at ages under twenty-seven and above eighty-one, but between those ages the Canadian men showed a lower mortality, falling as low as 84 per cent of the American man rate at age fifty-five.

The experience of insurance on the lives of women in the United States and Canada showed similar results when compared with the experience on men in the respective countries, the mortality in each case being higher on women during the first five insurance years and at ages under forty in the ultimate table, and

lower at ages of forty and over in the ultimate table. On American women the aggregate death losses were 94.4 per cent of the expected according to the American men table, and in the experience on Canadian women, 97.9 per cent of the expected according to the Canadian men table.

In Volume II the first subject taken up is mortality according to plan. A summary of the results is given in the following schedule:

	Ratio Actual to Expected—Per cent
Ordinary life	102.2
19- and 20-payment life	94.3
19- and 20-year endowment	95.5
10-year term	102.2

It is interesting to note that the mortality experience on the 19- and 20-payment life policies is slightly better than on the 19- and 20-year endowment policies; this fact is possibly due to the offering of endowment policies on lives not considered eligible on the life plan.

The experience on 10-year term policies changed or converted during the original period was favorable, aggregating 88.8 per cent of the expected according to the general table. On those renewed or converted at the end of the period, on the other hand, the actual amounted to 108.4 per cent of the expected.

The analysis of mortality according to the habitat in the United States shows very interesting results, the mortality in the various sections ranging from 88.7 per cent of the expected in the wheat growing district of the Northwest to 124 per cent in a group of states bordering on the Gulf of Mexico. In Canada the results of the same kind of analysis were similar in so far as the location of best mortality is concerned, the ratio in the prairie provinces being 87.2 per cent of the general rate; but in this case the unfavorable mortality showing came from the provinces in Quebec, and is estimated to have been due to racial mortality. An investigation of the mortality among women in the Province of Quebec, although based on scanty material, indicated, so far as it went, a mortality 25 per cent above that among Canadian women as a whole.

In the analysis of the causes of death, the deaths from each cause are shown as percentages of total deaths and also as a ratio per $10,000 exposed to risk and are arranged in subdivisions according to duration and age at death. A comparison of the figures for the United States and Canada showed markedly greater death rates among American than among Canadian men from cerebral hemorrhage and apoplexy, organic diseases of the heart, diabetes, nephritis and Bright's disease, and a slightly greater death rate in the case of pneumonia. In the cases of accident, the Canadian death rates were higher.

The data pertaining to the investigation of mortality under policies for large amounts were not very extensive, but so far as the data went the indications pointed to a mortality in excess of the normal, the ratio for all policies of $50,000 or more being 116.7 per cent for all ages at entry and all durations combined; for aggregate amounts of $100,000 or over, this percentage was 131.2 per cent.

In that part of the work which is represented by Volume I, the committee

of the Actuarial Society had the coöperation of a committee of Insurance Department actuaries appointed by the National Convention of Insurance Commissioners, and in the entire work it had the coöperation of a committee appointed by the American Institute of Actuaries, at the invitation of the Actuarial Society.

ROBERT HENDERSON.

An Index Number for State School Systems, by Leonard P. Ayres. New York, Russell Sage Foundation, 1920. Pp. 70.

Great interest has recently been aroused in educational circles throughout the country by the appearance of Dr. Ayres's book. Coming as it does from the pen of this expert on the subject of educational statistics, it presents in an authoritative manner the results of a careful study of statistical information with regard to education. The author computes for the several state systems an index number based upon ten sets of educational data. The data included are the following:

1. Per cent of school population attending school daily.
2. Average days attended by each child of school age.
3. Average number of days schools were kept open.
4. Per cent that high school attendance was of total attendance.
5. Per cent that boys were of girls in high schools.
6. Average annual expenditure per child attending.
7. Average annual expenditure per child of school age.
8. Average annual expenditure per teacher employed.
9. Expenditure per pupil for purposes other than teachers' salaries.
10. Expenditure per teacher for salaries.

It will be noted that the first five of these items refer to attendance, and the last five to financial matters. The question naturally arises as to the degree to which these items indicate the efficiency of educational procedure in the several states. Are there not other items, such as the achievements of pupils in standardized tests, the courses of study, etc., which would indicate more reliably the efficiency of the educational process? Dr. Ayres answers questions such as this in the following manner:

"If some great national agency were to undertake a survey of each of the forty-eight state school systems, it would surely report on many phases of their work not included in the items of the index. Among such phases would be the legal basis of the system, its organization, professional leadership and supervision, business management, course of study, teaching staff, plant and equipment, and the results of standard tests of classroom work.

"These elements, and others like them, are not directly included in the index, although some of them are crudely measured by the several items for financial expenditure. The sad fact is that, if there were available such information as surveys gather on most of the subjects suggested above, it would be still impossible to state the results in terms that could be included in an index number. The reason for this is that there is as yet little exact knowledge about education.

We do not know just what kind of teaching staff does the best work, or what kind of supervision is the most effective, or how many supervisors there ought to be, or how to measure organization in quantitative terms, or how to evaluate most of the other matters on which we report in survey making.

"Under present circumstances the best that can be done in an undertaking of the present sort is to take all the items for which continuous, reliable data can be secured and to combine them by as careful and impartial methods as can be brought to bear. In the present case it is to be regretted that only ten items could be found that seemed to meet the requirements that were laid down at the outset of the work. If the number of accurate and significant series used were greater, the reliability of the results would be enhanced."

The data and the index numbers based thereon are presented for the years 1890, 1900, 1910, and 1918. Tables are included showing the rank of each state for each of the four periods, and changes in rank are graphically indicated.

Table 13 presents two figures for each state for 1918, one figure based on the five data relating to attendance, and the other on the five financial in their nature. The author calls attention to a significant matter shown by this table. " . . . There is a generally close agreement between the educational figures in the first column and the financial ones in the second column in the matter of relative magnitude. In general, the high educational figures are accompanied by high financial ones, and the low educational totals by correspondingly low financial ones. This is one way of saying that a state having a long school term, high attendance, and many children in high school must pay more for the upkeep of its educational system than one which has none of these advantages. Another interpretation of the figures, which also is valid, is that the figures for school expenditures do have a close relation to those which show the amount of education given and tell how many are in high school, and that they are important indicators of the efficiency of the system and the quality of the education the children receive."

In reference to the accuracy of some of the data included, it should be noted that some times capital expenditures, such as loans for constructing new school buildings, are included by reporting authorities under the head of amounts spent for educational purposes, and sometimes they are not so included. Unless care be taken that uniform methods have been pursued in all cases, the validity of the relative standing of the several states would be impaired.

The author calls attention to the fact that large fluctuations take place in educational expenditures in cities on account of extensive building programs, and he states that "the use of the present index number would give misleading results if computed for cities." In some cases one or two large cities include a very large proportion of the population of a state. In such cases the accuracy of comparison among states may be impaired.

The year 1918 is, perhaps, not a good one for comparison of index numbers, because it occurred during a period when teachers' salaries were being adjusted throughout the United States on account of the increased cost of living. In some states a new salary scale had already been adopted in 1918, while in others a new scale was still under consideration. Under these conditions, comparison

of index numbers in 1920 or in 1921 would give a more accurate indication of the rank of the several states. Of course, it may be stated in reply that the figures for 1918 show the conditions as they existed during that year.

In the summary, Dr. Ayres states that "in general the index number should be regarded as reliable rather than precise. Its methods are rigid and impartial, but not considerative nor interpretative. It measures results without considering causes. The purposes of the index number is to make it possible for state school systems to measure their progress from year to year, and to compare their attainments with those of their neighbors."

This book will certainly help to concentrate attention upon the importance of the ten items in the operation of state school systems, and will stimulate all those concerned with public education to increased effort. Dr. Ayres has done a valuable piece of work which will tend to benefit public education.

DAVID E. WEGLEIN.

Baltimore.

Some Dangers in Establishing a Pension System and the Proper Precautions, by Edward L. Dodd. (University of Texas Bulletin, No. 1905.) 1919. Pp. 1 to 26.

In this monograph, Mr. Dodd takes as a model the pension system of the Teachers' Insurance and Annuity Association of America, organized by the Carnegie Foundation. He points out the leading features of this system and urges that the pension systems which some institutions might establish independently should be modeled after the pattern of the Teachers' Association.

Mr. Dodd lays down the following principles as the cardinal requirements of a pension system:

1. The pension must be paid out of a pension fund accumulated and administered in accordance with sound actuarial principles. It must not be paid by an institution out of the current salary budget.

2. This pension fund rightly belongs to the teachers who are to be the pensioners, because it is made up of portions of their salaries, the payments of which have been deferred to pension age. Mr. Dodd argues that if an institution did not maintain a pension system, it would be in a position to pay larger salaries to the teachers because the amounts paid out in pensions could be distributed among the teachers in the form of larger salaries.

3. Since the instructor pays for his pension, either in the form of direct contribution into the fund or in the form of a reduced salary because his institution maintains the pension fund, each instructor should be required to pay the cost of his own pension only and should not be taxed to bear part of the cost of the pension of the older men. In other words, each generation should pay for itself.

4. If the periodical contributions to the pension fund are invested at 4 per cent compound interest, the cost of the pension to each beneficiary will be cut in two, for the reason that at such compound interest rate, the annual contributions to the pension fund in the course of 30 or 35 years are approximately doubled by the interest earnings. Therefore, if an institution pays pensions out of the current salary budget and not out of a reserve fund specifically created for

that purpose, the amount available for the payment of the salaries of the active instructors is diminished by approximately double the sum that would be required if pensions were paid out of a pension fund, where provision has been made for interest earnings.

5. If an instructor leaves the institution before pensions are payable, his interest in the pension fund should not be forfeited.

6. If he dies before the pension age, then the reserve accumulated to his credit in the pension fund, both principal and accrued interest, should be paid over to his family. The Tontine feature must not be employed in deferred pension systems.

7. The pension fund must be administered in accordance with the actuarial principle that the reserve must at all times be equal to the present value of the future pension obligations.

8. Where a pension system is in vogue, the pension should not be regarded as a future expense, but immediate provision must be made for these future obligations, and the reserve should be carried as a liability of the institution.

The big problem, of course, that confronts any institution that would establish a pension reserve fund, centers around the older teachers, who are near pension age, and for whose pensions special provision must be made in the pension fund. As a general principle, Mr. Dodd suggests that in order to establish a pension fund, an institution should declare a general increase in salaries, which increase is to be paid not directly to the teachers, but set aside for them into the pension fund. This increase is to be made retroactive in accordance with the length of service of the teaching staff, and a certain rate of compound interest is to be allowed on this retroactive increase, so as to bring the fund up-to-date. In this retroactive increase, account should be taken of the past rates of salary increases and also of the rate of increase in cost of living. But where this retroactive increase is to come from, Mr. Dodd does not state.

Mr. Dodd has treated his subject ably, and his pamphlet is well worth the study of college and other executives who are confronted with the pension problem. There is an interesting fallacy, however, in Mr. Dodd's reasoning. He assumes that each institution maintains a wage or salary fund for its teaching staff. This may be true where colleges pay their teachers' salaries out of the proceeds of special endowment funds. In such cases it may be presumed that the salaries are paid out of the proceeds or earnings derived from the endowment fund. But it does not necessarily follow that the pensions are paid at the expense of the active teaching staff, if an institution pays pensions out of the current salary budget. A simple change in bookkeeping would effect a division of the salary endowment fund into two parts, the income from one part to be applied to the payment of salaries, and the income from the other part to be applied to the payment of pensions. Thus, the payment of pensions out of a current salary budget may well be regarded as being made out of a pension fund. Such a system, however, makes no provision for teachers who leave the service of the institution. In this contention, Mr. Dodd will meet with unanimity of opinion among the teaching staffs.

Is not the following compromise solution feasible:

1. That when a college establishes a pension fund, all instructors should make contributions into this fund on the basis of age twenty-eight, which is the average age of an instructor on appointment.

2. As to the instructors who are between the ages of twenty-eight and fifty-five at the time of the institution of the pension system, the college should pay into the pension fund on their behalf the difference between the rate at their attained age and age twenty-eight.

3. This pension fund should not seek to provide for the pensions of instructors who are over fifty-five at the time the system is instituted. But when they reach the age of retirement, their pension should be paid out of the general salary fund of the institution. They should, however, contribute to this salary fund, the basic annual rates obtaining for age twenty-eight.

It would seem that the difficulties in the way of inaugurating a pension system on this basis should not be nearly so great as the practical difficulty of declaring a retroactive salary increase with compound interest over a number of years.

This suggestion is frankly a compromise, which may more readily solve in a simple manner some of the perplexing problems that arise in connection with the establishment of a pension fund system by any institution. In time, of course, as the older men die and the younger men who have been started correctly on the pension fund basis grow old, the fund will take care of all the pension requirements of the staff of the institution, whether the fund is administered by the institution directly or by an insurance company.

I. S. Adlerblum.

New York

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